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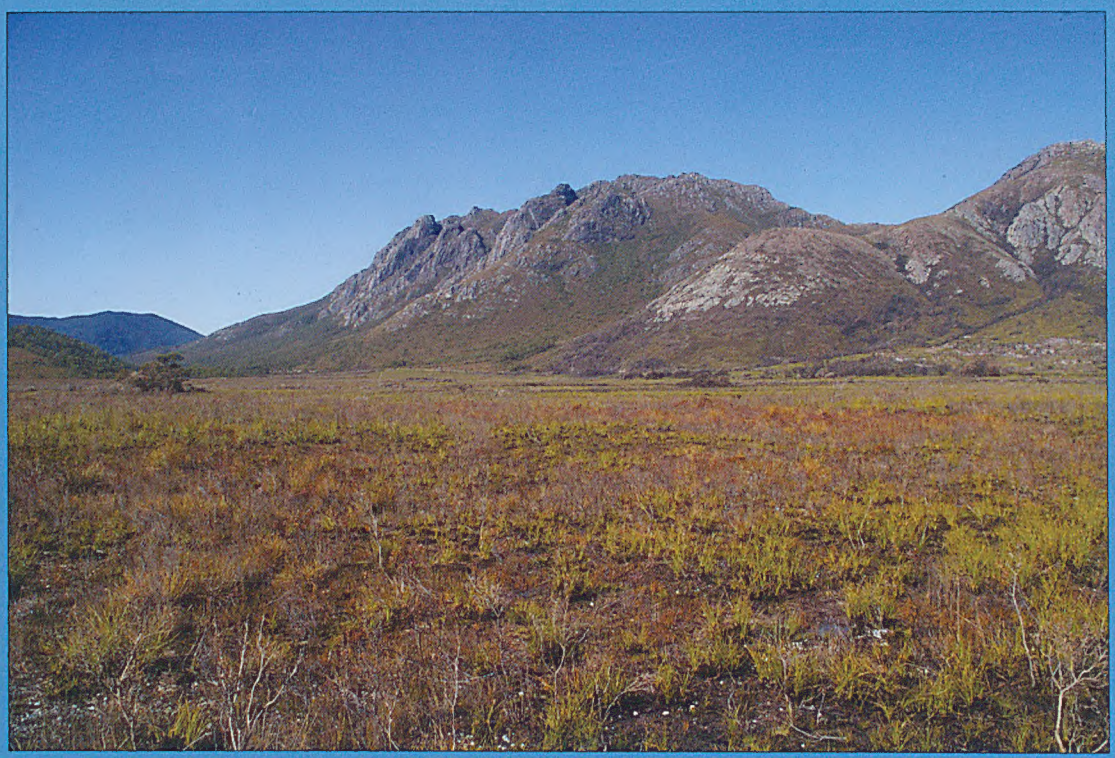

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Cover photograph: Buttongrass moorland at McPartlan Pass, SW Tasmania. (Photo: M. Driessen)

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PAPERS AND PROCEEDINGS OF THE ROYAL SOCIETY OF TASMANIA

VOLUME 148

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DISTRIBUTION AND CONSERVATION STATUS OF TWO ENDEMIC TASMANIAN CRUSTACEANS, *ALLANASPIDES HICKMANI* AND *ALLANASPIDES HELONOMUS* (SYNCARIDA: ANASPIDIDAE)

by Michael M. Driessen, Stephen A. Mallick, Shaun Thurstans, Bradley Smith and Raymond Brereton

(with one text-figure, three plates and three tables)

Driessen, M.M., Mallick, S.A., Thurstans, S., Smith, B. & Brereton, R. 2014 (19:xii): Distribution and conservation status of two endemic Tasmanian crustaceans, *Allanaspides hickmani* and *Allanaspides helonomus* (Syncarida: Anaspididae). *Papers and Proceedings of the Royal Society of Tasmania* 148: 1–9. ISSN 0080-4703. Biodiversity Conservation Branch, Department of Primary Industries, Parks, Water and Environment, PO Box 44, Hobart, Tasmania, 7001, Australia (MMD*, SAM, ST); Hydro Tasmania, 89 Cambridge Park Drive, Cambridge, Tasmania, 7170, Australia (BS, RB). *Author for correspondence: Email: Michael.Driessen@dpipwe.tas.gov.au

Extant representatives of the ancient crustacean family Anaspididae (Syncarida) are restricted to the island state of Tasmania, Australia. The most recently described species, *Allanaspides helonomus* Swain, Wilson, Hickman & Ong, 1970 and *A. hickmani* Swain, Wilson & Ong, 1971, were described from buttongrass moorland in southwestern Tasmania. Large areas of their habitat were subsequently inundated for hydroelectric power generation. We surveyed the extant distributions of *A. hickmani* and *A. helonomus*, assessed potential threats to the species, and reviewed their conservation status against state, national and international criteria. *A. hickmani* is restricted to a single catchment and occurs in a very small number (<10) of highly fragmented subpopulations on the margins of two hydroelectric impoundments. *A. helonomus* has a substantially larger range and Area of Occupancy spanning three separate catchments, and is now known to also occur in the Lake Pedder hydro-electric impoundment. Both species are listed as vulnerable on the IUCN Red List. This listing appears warranted for *A. hickmani* based on its restricted Area of Occupancy and the small number of extant subpopulations. However, *A. helonomus* no longer appears to fulfil the IUCN criterion for vulnerable. Neither species appears to be eligible for listing as vulnerable under the Australian *Environment Protection and Biodiversity Conservation Act 1999* and the Tasmanian *Threatened Species Protection Act 1995*. The current listing of *A. hickmani* as rare under the Tasmanian *Threatened Species Protection Act 1995* appears warranted as extant subpopulations may be at risk of extinction. The level of risk for *A. helonomus* is considerably lower than is the case for *A. hickmani*, and *A. helonomus* may not be eligible for listing as rare. The potential impacts of climate change on buttongrass moorland may present the most serious long-term threat to the two *Allanaspides* species.

Key Words: threatened species, IUCN Red List, EPBC, impoundments, climate change, buttongrass moorland, Tasmania, *Allanaspides hickmani, Allanaspides helonomus*

INTRODUCTION

The superorder Syncarida is a group of small to minute crustaceans known to have existed as early as the Carboniferous period (Schram 1984, 2003). Syncarids were known only from fossil representatives for some 45 years before the first living representative, the "shrimp-like" *Anaspides tasmaniae* Thomson, 1892 (Anaspididae), was discovered living in mountain pools in Tasmania (Schram 1984). A further two extant genera in the Anaspididae (*Paranaspides* and *Allanaspides*) have since been described from Tasmania, including *Allanaspides helonomus* Swain, Wilson, Hickman & Ong, 1970 (Marsh Pygmy Shrimp) and *A. hickmani* Swain, Wilson & Ong, 1971 (Hickman's Pygmy Shrimp). All extant representatives of the Anaspididae bear a close resemblance to the fossil syncarids, and can be regarded as "living fossils" (Schram & Hessler 1984, Dawson 2003).

The two species of *Allanaspides* are of particular conservation concern because both have limited distributions and both have lost a large proportion of their original range as a result of inundation for hydroelectric power generation (Driessen *et al.* 2006). In 1986, both species were listed as vulnerable on the International Union for Conservation of Nature (IUCN) Red List. Neither species is listed under the *Australian Environment Protection and Biodiversity Conservation Act* 1999 (EPBCA). However, in 1995 *A. hickmani* was listed as rare under the *Tasmanian Threatened Species Protection Act* 1995 (TSPA).

The two *Allanaspides* species are similar in general appearance and size (≤15 mm in length), but differ in the shape and colouration of the unique ion-exchange organ (fenestra dorsalis) found on the cephalothorax of both species. Both *A. hickmani* and *A. helonomus* have adopted a semelparous life cycle lasting around 14–15 months and with little overlap in generations (Swain 2000, Driessen & Mallick 2007). Juveniles first begin to appear around late February (late summer) and reach sexual maturity several months later. Reproduction and egg-laying occur from around June onwards, with eggs apparently remaining dormant over the summer months (December to February) until hatching the following year (Driessen & Mallick 2007). For both species of *Allanaspides*, the survival of eggs over the dry summer months is of critical importance for populations to survive and persist into the following year.

Both *Allanaspides* species were first recorded in pools in buttongrass moorland within the Gordon River and Serpentine River drainage systems prior to inundation of the two valleys for hydroelectric power generation (Swain *et al.* 1970, 1971). The flooding created a new impoundment, Lake Gordon, and it greatly enlarged the

pre-existing Lake Pedder. The two species are thought to have evolved in adjacent catchments during the Quaternary from a common lake-dwelling ancestor (Knott 1975). *A. hickmani* was first recorded from McPartlan Pass (which straddles the lowest point in the catchment divide between Lake Gordon and Lake Pedder, pl. 1), and at Trappes Inlet (subsequently inundated by the Lake Pedder impoundment) (Swain *et al.* 1970, 1971, R. Swain unpublished data; fig. 1). Post-inundation surveys for *Allanaspides* by Horwitz (1988, 1989) located a single additional population of *A. hickmani* at Coronation Bay on the western shore of Lake Pedder (fig. 1).

Allanaspides helonomus was first recorded from a site (now inundated) near the original Lake Pedder within the Serpentine drainage system, with a second record from McPartlan Pass on the Lake Gordon side of the catchment divide (Swain *et al.* 1970). Post-inundation surveys by Horwitz (1988, 1989) located *A. helonomus* at several additional locations around the margins of Lake Pedder and at a site in the Crossing Plains area which is located in the Port Davey catchment to the south of Lake Pedder (fig. 1). Neither *A. helonomus* or *A. hickmani* were recorded in crayfish burrows or moorland pools during freshwater invertebrate surveys of the lower Gordon River, Denison and Olga River plains and Rookery Plains (Richardson & Swain 1978). *Allanaspides* species are commonly found in small pools, often less than 2 m in diameter and only a few centimetres deep, in buttongrass moorlands. It has been assumed that both *Allanaspides* species are obligatory pool-dwellers which do not occur in lake-waters (Horwitz 1990, Driessen *et al.* 2006). Surveys of the macro-invertebrate fauna of the original Lake Pedder (Bayly *et al.* 1966) and of nearby Lake Edgar (Knott & Lake 1974) prior to their inundation failed to record the presence of *Allanaspides*. Invertebrate surveys of both the Lake Pedder and Lake Gordon impoundments have also failed to record either *Allanaspides* species (Lake 2001, M. Driessen unpublished data). However, a number of *A. helonomus* were collected in 1997 during a diving survey at a depth of 24 m in the channel between Sprent Basin and Bell Basin in Lake Pedder (Nigel Forteath, pers. comm.) (fig. 1). Although this information and a photograph of a specimen were forwarded to the Tasmanian Inland Fisheries Service at the time, we did not become aware of this observation until November 2008 when a slide of the *A. helonomus* specimen was given to one of the authors (MD).

Here, we review the conservation status of *A. hickmani* and *A. helonomus* at international, national and state scales. This review is based on recent distributional surveys for both species and an assessment of potential threats.

MATERIALS AND METHODS

Allanaspides searches in buttongrass moorland

Areas of *Allanaspides* habitat to be searched were identified using 1:25,000 topographical maps and knowledge of the vegetation and topography of the area. Potential habitat included areas of flat or gently sloping (slope ≤ 5 degrees) buttongrass moorland which contained standing pools. *Allanaspides* spp. rarely occur in buttongrass moorland on steeper slopes due to a shortage of standing pools especially those containing crayfish (*Ombrastacoides* spp. and *Spinastacoides* spp.) burrows which appear to provide refuge for *Allanaspides* during summer months when the majority of surface pools dry out (Swain 2000, Driessen & Mallick 2007). Surveys of potential habitat commenced within the previously-known range of the species and then systematically expanded out until the species were not recorded. Because of limited road access in this part of Tasmania, most sites were accessed by foot, boat (to shorelines) and helicopter (table 1). Surveys were conducted during November and December when most *Allanaspides* have attained their maximum size and animals are easiest to detect.

Once on site, an initial assessment was made for the presence of surface pools at least three centimetres in depth that included crayfish burrows. Where suitable pools were present, pools were sampled within a 100 m radius of a central point (this area is referred to as a search "site"). Occasionally, slow-moving streams or seeps and pools shallower than 3 cm were also sampled.

Suitable pools were checked initially by eye for the presence of *Allanaspides*. Any individuals detected by eye were caught using sieves (10 cm diameter, 1 mm pore size) and identified to species on site (pl. 2). Particular attention was given to the deeper areas around the entrance to crayfish burrows. If no *Allanaspides* were observed, the sieve was vigorously swirled through the pool, stirring up the water column which was then sieved. The products of sieving were then emptied into a plastic tray and searched by eye for *Allanaspides*.

At each site between five and 30 pools were sampled depending on the number of pools present within a 100 m radius. For sites with numerous pools and where *Allanaspides* were present, an *Allanaspides* individual was generally found within the first five pools sampled (M. Driessen unpublished data). Therefore, a site where five or more suitable pools were searched without locating any *Allanaspides* was classed as a "not present" site.

Lake searches for *Allanaspides*

Lake surveys were conducted over two days in 2009 (Lake Pedder) and over three days in 2010 (Lake Gordon). The survey in Lake Pedder included snorkelling and plankton net tows, while only plankton net tows were used to survey Lake Gordon. A plankton net with a 40 by 40 cm steel frame opening was used to survey for *Allanaspides* in both impoundments (pl. 3). To survey a location in the lake, the net was slowly dragged along the lake bottom for 2–5 m before lifting to the surface, decanting any material into a plastic tray and checking for *Allanaspides*.

Snorkelling was restricted to depths of less than 1.5 m because tannin in the water caused loss of visibility at greater depths. Snorkeling was conducted at two locations in Lake Pedder; on either side of an isthmus at the southern

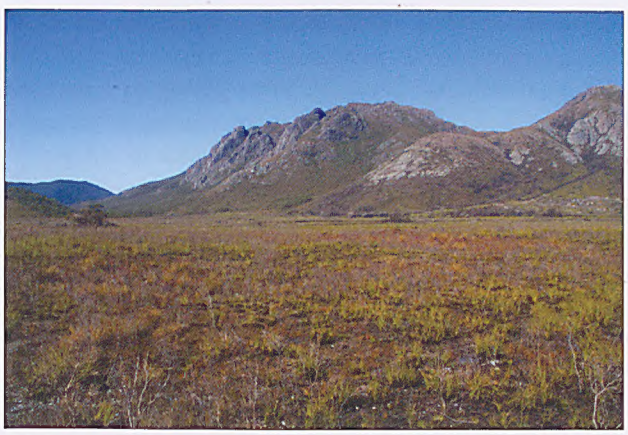

PLATE 1 — Buttongrass moorland at McPartlan Pass where both *Allanspides hickmani* and *A. helonomous* occur in pools. (Photo: M. Driessen)

PLATE 2 — Surveying for *Allanaspides* in moorland pools using a dip net and sorting tray. (Photo: B. Heap)

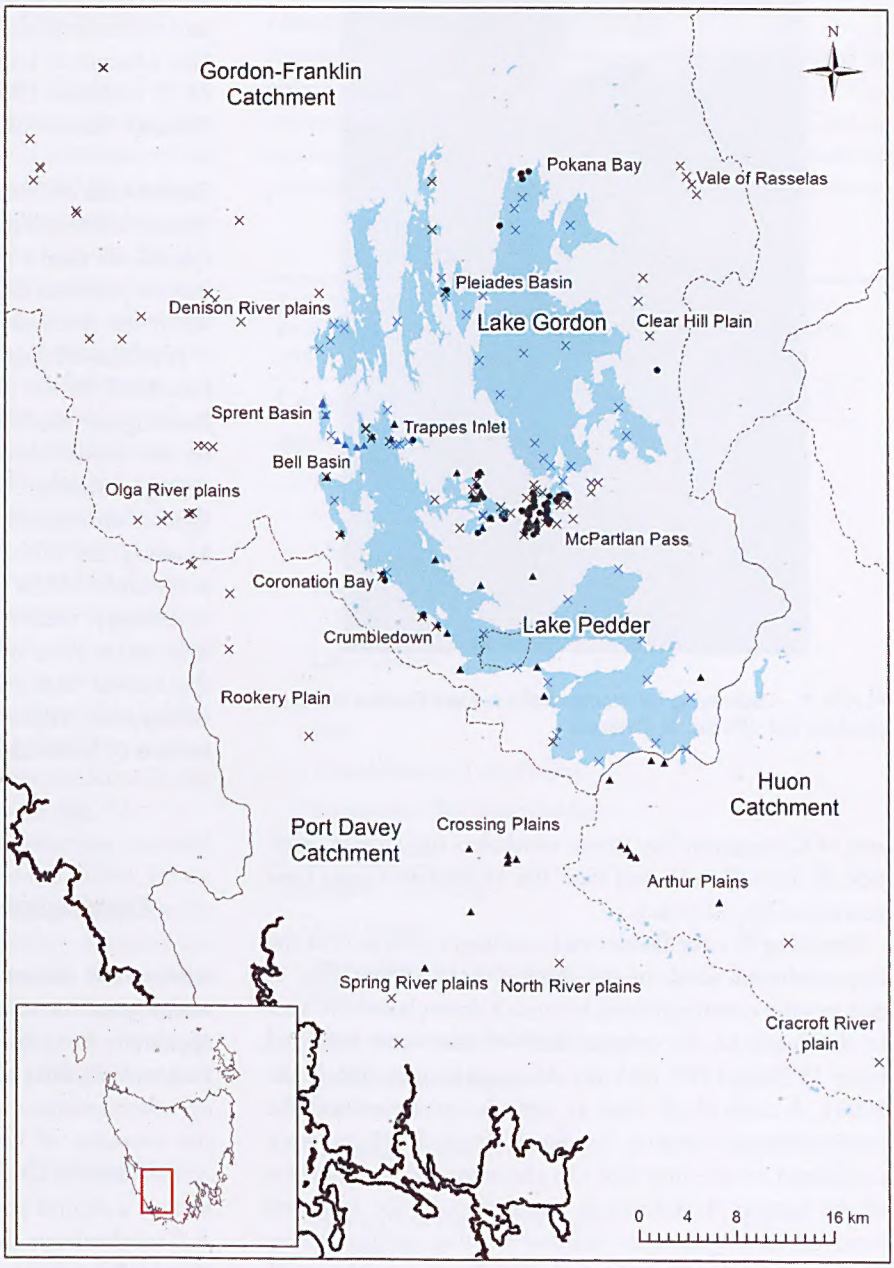

FIG. 1 — Location of survey sites for *Allanaspides hickmani* and *A. helonomus* in southwest Tasmania. Figure includes sites surveyed where *Allanaspides* were recorded by Swain *et al.* (1970, 1971) and Horwitz (1988, 1990) and sites surveyed but where no *Allanaspides* were recorded by Richardson & Swain (1978), Horwitz (1988, 1990) and Lake (2001). Shaded areas = water bodies. Solid triangles = *A. helonomus* sites, solid circles = *A. hickmani* sites, crosses = sites where *Allanaspides* were not recorded, blue symbols = lake sites, black symbols = non-lake sites. Location of catchment boundaries and selected place names are also shown. Solid black line = coastline, dashed lines = catchment boundaries, thin black line = location of Lake Pedder prior to inundation.

TABLE 1 — Details of searches for *Allanaspides*

Year	Month	Person days[1]	Area searched	Access methods
2001	Nov-Dec	18	McPartlan Pass area, Vale of Rasselas	foot
2002	Nov	6	Shorelines of Lake Gordon and Lake Pedder	boat
2004	Nov	2	Arthur Plains	foot
2004	Dec	2	Crossing Plains, Arthur Plains	helicopter
2006	Nov	6	Denison River, Maxwell River, Olga River, Hardwood River, upper Davey River, Crossing Plains, Spring River, Arthur Plains, North River, Adams River, Clear Hill Plains	helicopter
2009	Nov	6	Waters of Lake Pedder	boat
2010	Dec	9	Waters of Lake Gordon	boat

[1] number of personnel × number of days searching

PLATE 3 — Surveying for *Allanaspides* in Lake Gordon using a plankton net. (Photo: M. Driessen)

end of Coronation Bay (three snorkelers for 15 min. each side of the isthmus), and near the McPartlan Canal (two snorkelers for 30 min.).

Sampling in Lake Pedder was confined to the part of the impoundment north of the original Lake Pedder (fig. 1) due to time constraints and because a dozen lakeshore sites to the south of the original Lake Pedder were surveyed from 1975 to 1989 with no *Allanaspides* recorded (Lake 2001). A total of 28 tows at eight locations around the impoundment ranging in depth from 2–28 m were conducted on the first day. On the second day the extent of the known *A. helonomus* population in the lake was surveyed in a systematic manner starting within Sprent Basin and heading out through Bell Basin into the main part of the impoundment (fig. 1).

Sampling in Lake Gordon was designed to cover as much of the lake area as possible and to include a range of depths and substrate types. Attention was also given to parts of the lake adjacent to known buttongrass moorland populations of *A. hickmani* (Wedge Inlet near McPartlan Pass canal, Pleiades Basin, Pokana Bay and Adams Bay) (fig. 1).

Extant Area of Occupancy of *Allanaspides*

To estimate the extant Area of Occupancy of both *Allanaspides* species, we used a model based on vegetation and slope to predict potential *Allanaspides* habitat within the catchments where the species are known to occur.

Potential *Allanaspides* habitat was modelled as buttongrass moorland on flat or very gently sloping land (slope ≤5°). Buttongrass moorland vegetation communities included in the model were; MBS Buttongrass moorland with emergent shrubs; MBP Pure buttongrass moorland; MBR Sparse buttongrass moorland on slopes; MBW Western buttongrass moorland; and MSW Western lowland sedgelands (TASVEG database, Tasmanian Department of Primary Industries, Parks, Water and Environment). The extant Area of Occupancy for the two *Allanaspides* species was then calculated as the sum of all patches of *Allanaspides* habitat in catchments where the species are known or believed to occur.

RESULTS

Distribution of *Allanaspides hickmani*

Allanaspides hickmani was recorded at numerous sites in buttongrass moorland at McPartlan Pass, and the species appears to be common in remaining habitat at McPartlan Pass on both sides of the catchment divide (fig. 1). Searches of other remnant patches of moorland habitat around the shoreline of Lake Pedder confirmed the presence of *A. hickmani* at Coronation Bay (cf. Horwitz 1988), and located a second population in a small patch of moorland at Crumbledown also on the western shore of Lake Pedder (fig. 1). No other populations of *A. hickmani* were located around Lake Pedder (fig. 1). Searches of suitable habitat

around the shoreline of Lake Gordon located *A. hickmani* at Pokana Bay at the northern tip of the impoundment, on the western side of Pokana Bay, at Pleiades Basin, and in Clear Hill Plain area to the east of Lake Gordon (fig. 1).

Searches of suitable moorland habitat elsewhere within the Gordon–Franklin catchment (in the Denison River Plains and Olga River Plains to the west, and in the Vale of Rasselas and the northern end of Clear Hill Plain to the east) failed to locate additional populations of *A. hickmani*. The species was also not recorded in areas of suitable habitat in either the Huon or Port Davey catchments (fig. 1). In total, *A. hickmani* is now known to occur at three separate locations around Lake Pedder (McPartlan Pass, Coronation Bay and Crumbledown) and at five locations around Lake Gordon River (McPartlan Pass, Pokana Bay, west Pokana Bay, Pleiades Basin, Clear Hill Plain).

Surveys of the lake waters of both Lake Pedder and Lake Gordon failed to capture any *A. hickmani* (fig. 1).

Distribution of *Allanaspides helonomus*

Allanaspides helonomus was recorded at McPartlan Pass on both sides of the catchment divide, although on the Lake Gordon side of the divide *A. helonomus* is restricted to the westernmost section of the McPartlan Pass plain (fig. 1). Apart from McPartlan Pass, *A. helonomus* was not recorded in areas of suitable habitat elsewhere around Lake Gordon (fig. 1).

Allanaspides helonomus was recorded at numerous sites around the shoreline of Lake Pedder (fig. 1). *A. helonomus* was also recorded at several sites in the Arthur Plains in the Huon catchment (fig. 1). However, *A. helonomus* was not recorded in the Cracroft River plain to the south of the Arthur Plains despite the presence of flat buttongrass moorland which appeared to be suitable for the species, and the Arthur Plains appears to be the southerly most extent of *A. helonomus* within the Huon catchment (fig. 1).

Allanaspides helonomus was recorded at a number of sites in the Crossing Plains area in the Port Davey catchment, and the species was also recorded to the south of the Crossing Plains at two sites in the Spring River plains area (fig. 1). *A. helonomus* was not recorded in searches of suitable habitat in the North River plains area (west of Spring River plains), or from the Rookery Plains on the Hardwood River in the western part of the Port Davey catchment (fig. 1).

In the waters of Lake Pedder, *A. helonomus* was recorded in Sprent Basin, Bell Basin, from the mouth of Bell Basin, and in the main part of the impoundment immediately outside the mouth of Bell Basin (total area = 4.6 km^2; fig. 1). Most locations where *A. helonomus* was found were 20 m depth or greater except within Sprent Basin where the species was recorded between 6 and 15 m depth. *A. helonomus* was not recorded in searches of the lake waters of Lake Gordon (fig.1).

Extant Area of Occupancy of *Allanaspides*

Allanaspides hickmani

Around Lake Gordon, most patches of predicted *Allanaspides* habitat which were searched were found to support *A. hickmani*. We therefore estimated the extant Area of Occupancy of *A. hickmani* around Lake Gordon as the sum of all patches of *Allanaspides* habitat (including all searched patches where *A. hickmani* was recorded plus several small patches of habitat which were not searched) minus those patches of habitat which were searched but where *A. hickmani* was not recorded. Using this method, the total Area of Occupancy for *A. hickmani* around Lake Gordon was estimated to be 13.3 km^2 (table 2).

In contrast, around Lake Pedder, only a small fraction of the predicted *Allanaspides* habitat was found to support *A. hickmani*. The extant Area of Occupancy for *A. hickmani* around Lake Pedder therefore included only those patches of habitat (at McPartlan Pass and the two sites on the western shore of the impoundment) which contained at least one record of *A. hickmani* (total area = 6.7 km^2; table 2).

The total Area of Occupancy of *A. hickmani* was therefore estimated to be 20.0 km^2 (table 2).

Allanaspides helonomus

Around Lake Gordon, *A. helonomus* has been recorded in only a small area of the McPartlan Pass plain (fig. 1). The extant Area of Occupancy of *A. helonomus* within the Gordon catchment was therefore calculated as the sum of habitat patches at McPartlan Pass which were searched and where

TABLE 2 — Estimated areas of extant Area of Occupancy for *Allanaspides hickmani* and *A. helonomus* by catchment and location

Catchment and location	Area of habitat (km^2)
Allanaspides hickmani	
McPartlan Pass (Lake Gordon side)	4.9
Clear Hill Plain	4.1
Pokana Bay (Lake Gordon)	3.3
Additional small areas around Lake Gordon	1.0
McPartlan Pass (Lake Pedder side)	3.4
Crumbledown (Lake Pedder)	1.5
Coronation Bay (Lake Pedder)	1.8
A. hickmani total	20.0
Allanaspides helonomus	
Lake Pedder	4.6
McPartlan Pass (Lake Gordon side)	0.2
Total area around Lake Pedder	37.5
Arthur Plains (Huon catchment)	33.0
Crossing Plains (Port Davey catchment)	40.3
Spring River Plains (Port Davey catchment)	14.3
A. helonomus total	129.9

A. helonomus was recorded (total area = 0.2 km²; table 2).

In contrast, around Lake Pedder, the majority of patches of suitable moorland habitat which were searched were found to support *A. helonomus*. We therefore estimated the Area of Occupancy for *A. helonomus* around Lake Pedder as the sum of all patches (searched and unsearched) of suitable habitat (total area = 37.5 km²; table 2).

The Arthur Plains, Crossing Plains, and Spring River Plains involved extensive tracts of potential *Allanaspides* habitat which received relative little sampling effort. For these extensive but poorly sampled areas of habitat, including only patches of habitat containing an *A. helonomus* record is likely to significantly underestimate the species' Area of Occupancy. Therefore, for the Arthur Plains, Crossing Plains and Spring River Plains, all patches of potential *Allanaspides* habitat within a sub-catchment containing at least one record of *A. helonomus* were assumed to support the species (Arthur Plains, 33.0 km²; Crossing Plains, 40.3 km²; Spring River Plains, 14.3 km²; table 2). The Cracroft River plain was not included in the Area of Occupancy estimate because no *A. helonomous* was found there and a watershed boundary exists between it and the Arthur Plains.

The estimated Area of Occupancy for *A. helonomus* in the lake waters of Lake Pedder was 4.6 km². The total Area of Occupancy for *A. helonomus* was therefore estimated to be 130 km² (table 2).

DISCUSSION

Allanaspides in lake waters

All documented records of *Allanaspides* prior to the present study have been from pools in buttongrass moorland (Swain *et al.* 1970, 1971, Horwitz 1988, 1989, Driessen *et al.* 2006, Driessen & Mallick 2007), and it has been assumed that both *A. hickmani* and *A. helonomus* are obligate pool-dwellers that do not occur in lake-waters proper (cf. Driessen *et al.* 2006). A survey of the macro-invertebrate fauna of the original Lake Pedder prior to its inundation by Bayly *et al.* (1966) did not record any (at that time undescribed) *Allanaspides*. Sampling by Bayly *et al.* (1966) included plankton net tows in the shallow littoral zone of the lake, and handnet, dredge and grab samples of the benthos in the littoral zone and in the deeper parts of the lake. It therefore seems reasonable to conclude that *Allanaspides* did not occur in the waters of the original Lake Pedder. The finding of *A. helonomus* within the waters of the Lake Pedder impoundment is therefore unexpected, and has significant implications for the conservation of the species.

The distribution of *A. helonomus* in Lake Pedder appears to be confined to deeper waters (>20 m) in the vicinity of Sprent and Bell Basins (fig.1). The depth of the majority of Lake Pedder is less than 15 m (Kiernan 2001). The absence of the species from shallower parts of Lake Pedder may explain why the species was not detected during previous invertebrate surveys which focused on the littoral zone of the impoundment (Lake 2001, M Driessen unpublished data).

The reasons why *A. helonomus* occurs only in one section of Lake Pedder may relate to a combination of sheltered aspect, substrate type and depth. The Sprent and Bell are deep basins (> 20 m in depth) located over the original Serpentine River valley. These basins are also situated in the northwestern part of the impoundment and are sheltered from northwesterly and westerly wind action. A combination of sheltered aspect and deep waters with reduced wave action allows the formation of a silty substrate (Davies 2001) which may be required by *A. helonomus* to survive in lake waters. Surveys in another Tasmanian lake, Great Lake in the Central Highlands, have shown that silty substrates and algal beds, which are important habitats for a range of fauna including the anaspidid syncarid *Paranaspides lacustris*, only occur on shorelines sheltered from pre-frontal north-westerly and westerly winds (Davies & Fulton 1987, Davies 2001).

Predation by fish, including both native galaxids and introduced trout, may constrain the distribution of *A. helonomus* to deeper parts of the lake and explain the absence of the species from shallower waters. In the tannin-rich waters of southwestern Tasmanian lakes, fish predation may be limited to shallower waters with sufficient light for fish to locate prey by sight (Guthrie & Muntze 1993). Areas of the lake with deeper water plus a silty substrate may therefore provide a refuge for *A. helonomus* from intense levels of fish predation which occur elsewhere in the shallower parts of the impoundment.

Allanaspides hickmani is known to occur adjacent to the shoreline of Lake Pedder, yet the species was not recorded within the impoundment. *A. hickmani* appears to have very similar ecological requirements to *A. helonomus*, and the two species occur sympatrically in buttongrass moorland over part of their range (Horwitz 1988, present study), and are occasionally found in the same pool together (M. Driessen unpublished data). It is not clear why *A. hickmani* does not occur in those parts of Lake Pedder which support *A. helonomus*.

Both species of *Allanaspides* occur adjacent to the shoreline of Lake Gordon. However, neither species was recorded within Lake Gordon, despite the presence of sheltered, deep-water bays similar to the Sprent and Bell basins in Lake Pedder. Why neither species of *Allanaspides* occur in Lake Gordon is not known, but may relate to significant differences in the limnological attributes of the two impoundments. The generally shallower waters of Lake Pedder do not undergo significant stratification, so that the entire water column remains oxygenated year round, including water in the deeper parts of the impoundment (HydroTasmania 2011). In contrast, Lake Gordon stratifies each year with consequent anoxia below the thermocline, which in the colder months can occur at depths of around 30–40 m (Steane & Tyler 1982). These periodic periods of anoxia at depth may be the reason why neither species of *Allanaspides* has been able to establish in Lake Gordon.

Extant Area of Occupancy, inundation, and loss of *Allanaspides* habitat

Based on the known distributions of *A. hickmani* and *A. helonomus*, and assuming that neither *Allanaspides* species

occurs in lake waters, Driessen *et al.* (2006) estimated the extant Area of Occupancy for *A. hickmani* and *A. helonomus* to be 21 km² and 54 km², respectively. Driessen *et al.* (2006) also estimated the area of *Allanaspides* buttongrass moorland habitat inundated for hydro-electric impoundment to be 117 km² for the Lake Gordon impoundment and 191 km² for the Lake Pedder impoundment. This corresponded to a loss of 78% of the original habitat area for *A. helonomus* and 85–94% for *A. hickmani*.

Given that *A. hickmani* does not occur in the waters of either impoundment, and the estimate of extant Area of Occupancy for *A. hickmani* in the present study (20 km²) is similar to the earlier estimate in Driessen *et al.* (2006) (21 km²), the estimate by the latter study of 85–94% of *A. hickmani* habitat lost through inundation remains unchanged.

For *A. helonomus*, the upgraded estimate of extant Area of Occupancy in buttongrass moorland (125 km²), as well as the finding that *A. helonomus* occurs in the waters of Lake Pedder, requires a reconsideration of the estimate of habitat loss through inundation for this species. An updated estimate of *A. helonomus* habitat lost through inundation is 186.4 km², or 59% of the species' original range (Driessen *et al.* 2006; table 2).

Threats to *Allanaspides*

Prior to the present study, *A. hickmani* was only known from three disjunct localities in two adjacent drainage systems, with one of these locations (Trappes Inlet) having been inundated by flooding of the Serpentine catchment. Based on the results of the present study, *A. hickmani* is now known to occur at a total of eight sites on the periphery of Lake Pedder and Lake Gordon. The four new populations of *A. hickmani* located on the northern and eastern shoreline of Lake Gordon represent a significant extension in its known range, although the patches of habitat containing *A. hickmani* are relatively small (all <5 km² in area; table 2). McPartlan Pass represents the largest area of *A. hickmani* habitat still extant (4.9 km²; table 2), and successful management of the buttongrass moorland at McPartlan Pass will be crucial in ensuring the security of *A. hickmani* in the long term.

Prior to the present study, *A. helonomus* was known from a single locality at McPartlan Pass and from several locations around the margin of Lake Pedder (all in the Gordon–Franklin catchment), and from a single record in the Crossing Plains in the Port Davey catchment (Horwitz 1988, 1990). The results of the present study significantly extend the known distribution of *A. helonomus* within the Gordon-Franklin and Port Davey catchments, document the species in a third catchment (Huon), and expand the species' known habitats to include part of the water of Lake Pedder. Given the substantially larger extant distribution of *A. helonomus* spanning three major catchments and the fact that the species also occurs in lake waters, *A. helonomus* is likely to be much less vulnerable to threatening processes and stochastic events compared to *A. hickmani* (table 3).

Horwitz (1988, 1990) identified further inundation and fire as potential threats to *Allanapsides* species. A relatively minor increase in the level of either impoundment would inundate much of the remaining *A. hickmani* habitat which has survived on the margins of the current impoundments (Horwitz 1990). However, an increase in the impoundments' capacity is very unlikely, so further inundation does not pose an immediate risk to the species.

Buttongrass moorland is a pyrogenic community which requires repeated burning for the community to persist (Brown 1999), so the fauna associated with the buttongrass moorland (including *Allanaspides*) is presumably also adapted to repeated firing. However, very hot or excessively frequent firing of buttongrass moorland has the potential to damage the underlying peat (Horwitz 1990), thus a broad-scale, hot wildfire which burned a large proportion of the remaining *Allanaspides* habitat in a single event could pose a potential threat, particularly to the small number of remaining populations of *A. hickmani*. The peats of southwest Tasmania are also likely to become increasingly flammable under the predicted trend of warmer drier climates (Bowman 2008).

Perhaps of greatest concern to both *Allanaspides* spp. is the potential impact of global warming because the peatlands they occur in are predicted to be particularly vulnerable

TABLE 3 — Summary of information on principal criteria for threatened species listing for *Allanaspides hickmani* and *A. helonomus*

Criteria	*Allanaspides hickmani*	*Allanaspides helonomus*
Reduction in population size (in early 1970s)	85–94%	59%
Current or future declines	Unknown	Unknown
Extreme fluctuations (numbers, area, populations)	No	No
Extant Area of Occurrence	427 km²	939 km²
Extant Area of Occupancy	20 km²	130 km²
Population size	Unknown	Unknown
Fragmented populations	Yes (severe)	Yes
Extant populations	<10	Many

to climate change (Bowman 2008, DPIPWE 2010). The predicted changes in climate for Tasmania under a high and low CO_2 emissions scenario predict a mean increase in annual temperature of around 2.9 °C (high emissions scenario) and 1.6 °C (low emissions scenario) (Grose *et al.* 2010). Total annual rainfall is not predicted to change for the state as a whole; however a significant change in the spatial pattern of rainfall is predicted. For western Tasmania, rainfall is predicted to increase in winter and to decrease in summer. The cumulative effects on evaporation are predicted to be an increase in pan evaporation for the state of up to 19%, with the change in evaporation greatest in the north and west and greatest in summer (Grose *et al.* 2010).

The climate of southwest Tasmania is believed to be marginal for the formation of the blanket bogs which support buttongrass moorland, and small shifts in prevailing conditions, such as a rise in mean annual temperatures, could potentially cause the peats to degrade (Bridle *et al.* 2003), with far-reaching consequences to pool-dwelling species such as *Allanaspides*. The size, depth and longevity of surface pools in buttongrass moorland are also strongly influenced by the dryness of a particular season, and surface pools can be very scarce or absent in a dry summer (Swain 2000, Driessen & Mallick 2007). The sub-surface water in crayfish burrows is presumably more buffered against drying out during summer, although in prolonged periods of summer dryness many crayfish burrows can be without free water for several weeks (Swain *et al.* 1987). The impact of prolonged periods of summer dryness on these two semelparous species is limited by their capacity to produce diapausing eggs (Swain 2000, Driessen & Mallick 2007). However, a climatic shift leading to even a small fall in the water table and sub-surface drying-out of the peat could have a major impact on the ability of both *A. hickmani* and *A. helonomus* to survive in buttongrass moorland.

Threatened species status of *Allanaspides hickmani* and *A. helonomus*

We now consider the conservation status of *Allanaspides hickmani* and *A. helonomus* under international (IUCN), national (EPBCA) and state (TSPA) guidelines.

The IUCN, EPBCA and TSPA listing guidelines all have a criterion based on population decline over the recent past (i.e., over the last 10 years or within the past three generations of the species, whichever is the longer). Both *A. hickmani* and *A. helonomus* have undergone a significant reduction in range (59% and 85–94%, respectively) due to inundation of the Gordon and Serpentine catchments for hydroelectricity (Driessen *et al.* 2006 and the present study). However, inundation occurred over 30 years ago, making the species ineligible for listing under this criterion.

Both *A. hickmani* and *A. helonomus* were listed as Vulnerable on the IUCN Red List in 1986 under the IUCN criterion D2: population very small or restricted, with a very restricted Area of Occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that the species is prone to the effects of human activities or stochastic events within a very short time period. Based on the results of the present study, an IUCN listing of Vulnerable appears to be warranted for *A. hickmani* (Area of Occupancy estimated to be 20 km^2). However, *A. helonomus* no longer fulfils the IUCN criterion D2 for Vulnerable (Area of Occupancy estimated to be 130 km^2).

Neither the *EPBCA* nor the *TSPA* have a criterion corresponding to the IUCN criterion D2 for vulnerable. Under the *EPBCA* and *TSPA*, a species may be listed as Vulnerable if it has a restricted geographic distribution (Extent of Occurrence <20,000 km^2 or Area of Occupancy <2000 km^2) and its geographic distribution is precarious for the survival of the species based on the species fulfilling two of three sub-criteria: (1) highly fragmented or occurring in a limited number (n<10) of locations; (2) a continuing decline in range, habitat quality, subpopulations or numbers; and (3) extreme fluctuations in range, subpopulations or numbers.

Allanaspides helonomus fulfils the *EPBCA* and *TSPA* criterion for a restricted geographic distribution (Extent of Occurrence = 939 km^2 and Area of Occupancy = 125 km^2). However, *A. helonomus* does not fulfil any of the three sub-criteria; the species is not highly fragmented and is now known from three major catchments with numerous subpopulations; there is also no evidence for a continuing decline; and there is no evidence for extreme fluctuations in range or numbers. Therefore, *A. helonomus* is unlikely to qualify as Vulnerable under EPBCA or TSPA.

Allanaspides hickmani fulfils the *EPBCA* and *TSPA* criterion for a restricted geographic distribution (Extent of Occurrence = 427 km^2 and Area of Occupancy = 20 km^2). Furthermore, unlike *A. helonomus*, *A. hickmani* occurs in a limited number (<10) of small and highly fragmented populations, and the species is likely to fulfil the first sub-criteria for Vulnerable. However, there is no evidence that *A. hickmani* is subject to a continuing decline or extreme fluctuations in range or numbers. Therefore *A. hickmani* is also unlikely to qualify as Vulnerable under EPBCA or TSPA.

The TSPA differs from the EPBCA in having an additional listing category of Rare. A species may be listed as Rare if it has "a small population that is not endangered or vulnerable but is at risk". The indicative criteria for assessing a species as "at risk" include an Extent of Occurrence <2000 km^2. The current listing of *A. hickmani* as Rare under the TSPA appears warranted based on the species' restricted Extent of Occurrence (427 km^2), the small number highly fragmented subpopulations confined to a single catchment, and the stochastic risk of extinction of subpopulations.

Allanaspides helonomus is currently not listed as Rare under the TSPA. Based on the results of the present study, *A. helonomus* fulfils the extent of occurrence criterion for listing as rare (Extent of Occurrence = 939 km^2). However *A. helonomus* occurs in a relatively large number of populations spanning three major catchments and is now known to also occur in the waters of Lake Pedder. Its level of risk appears to be significantly lower than is the case for *A. hickmani* and although it has a restricted distribution there is no indication it is currently at risk

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ANTARCTIC VIGNETTES VIII: UNSUNG HEROES — RESEARCHING THE CREW OF THE S.Y. *AURORA* 1911–1914

by H.J.G. Dartnall

(with six plates and one table)

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The Steam Yacht *Aurora* made three voyages to the Antarctic and two to the sub-Antarctic during the Australasian Antarctic Expedition (AAE) 1911–1914. All told, 56 men served as members of the crew on these voyages. Most served on one or two voyages only, with just five men (four officers and one seaman) serving on all five. While the officers are reasonably well documented many of the seamen remain unknown though recent research has uncovered details of some of these unsung heroes of the AAE.

Key Words: crew, S.Y. *Aurora*, Australasian Antarctic Expedition

INTRODUCTION AND DISCUSSION

The men who comprised the crew of the S.Y. *Aurora* during the Australasian Antarctic Expedition (AAE) are probably the least well-known English-speaking ship's company of the heroic era of Antarctic exploration. There are several reasons for this; first, complete crew lists have only recently been published (FOM 2003, Riffenburgh 2011, Dartnall 2014); second, there was a rapid turnover of the crew who were a cosmopolitan mix of merchant seamen and, in many cases, we do not know where they came from; third, *Aurora* made five voyages into the Antarctic – more than any other expedition; and fourth, poor attention to paperwork at the time has led to some mistaken assumptions, not helped by the fact it all took place more than 100 years ago.

In *The Home of the Blizzard* the ship's company is reported as consisting of 24 men – five officers and 19 men (Mawson 1915), while Captain John King Davis, in his book *With the Aurora in the Antarctic*, states that the crew of the *Aurora* normally numbered 25 and proceeds to name 18 (Davis 1919). These figures do not tell the full story for while it is true that the crew at any time numbered in the low twenties, a total of 105 men can legitimately claim to have served on *Aurora* during the AAE (24 AAE, Riffenburgh 2011). Forty-nine of these men may be discounted as they did not go south. They were involved in bringing the *Aurora* to Australia from England and were discharged, or ran away on the way to, or in, Hobart. Or they either served briefly at the end of the expedition or when she was laid-up in Hobart for six months in 1913, or was travelling between Australian ports. This leaves 56 officers and men who served aboard *Aurora* on one or more of the three Antarctic and two sub-Antarctic cruises.

The crews of the five voyages are listed in table 1. From this table it is apparent that only five men – four officers (John King Davis, Percy Gray, Clarence Petersen de la Motte and Frederick Gillies) and one Able Seaman (Oswald McNeice) – took part in every voyage.

At that time ship's officers and crew of Antarctic Expeditions were eligible to receive the King's Polar Medal in bronze; but the case had just been made for those sailors on Scott's Last Expedition, the British Antarctic Expedition (BAE) of 1910–1913, who took part in two or all three of the voyages south to the Antarctic, to receive the medal in silver. The more senior award had previously only been given to men who had wintered (Poulsom & Myres 2000). Scott's men who made only one voyage south received a bronze Polar Medal (Poulsom & Myres 2000).

Douglas Mawson similarly argued for the AAE crew, noting that *Aurora*'s crew working under constantly changing ice and weather conditions experienced a harsher time than some of the winterers. Mawson's argument was accepted by the Polar Medal awards committee of the British Admiralty and silver Polar Medals were awarded to the five men who took part in every voyage south (listed above) as well as two First Officers – Frank Douglas Fletcher and John Hamilton Blair. Inexplicably no bronze medals were issued, and E.L. Adams, Harry Corner, James Forbes, Bernard McGrath, W. Maxfield, Norman Toutcher and C. (Gus) Williams, all of whom had been specially commended by Captain Davis for their work (176 AAE), together with the rest of the crew, received nothing.

The Captain's wages book (24 AAE) is the primary source for researching the crew of *Aurora*; but it is a working document and contains some errors so care must be taken when using it. Men with a common family name and just a single initial are always going to be difficult to trace. For example, we do not know if the G. Taylor who served as an Able Seaman on the Second Antarctic Voyage was George, Guy, Gerald, Garth or Graeme/Graham Taylor (or whatever) nor indeed where he came from. Consequently, without any other clues we are unlikely to find out more about him. There was another Taylor on the crew – G.R. Taylor in the Captain's wages book – who served as a stoker/fireman on the second sub-Antarctic cruise and the second Antarctic voyage. With two given initials there is always a bit more hope of success and, indeed, I was confidently researching a George Reay Taylor, a Gateshead man born in 1888 who at the end of the First World War was serving as a second mate and in possession of a Master's ticket issued

TABLE 1 — The crew of the S.Y. *Aurora* 1911–1914

Voyage	1st Antarctic	1st sub-Antarctic	2nd sub-Antarctic	2nd Antarctic	3rd Antarctic
Master	J. K. Davis	J. K. Davis	J. K. Davis	J. K. Davis	J. K. Davis
1st Mate	N. C. Toutcher	F. D. Fletcher	F. D. Fletcher	F. D. Fletcher	J.H. Blair
2nd Mate	P. Gray	P. Gray	P. Gray	P. Gray	P. Gray
3rd Mate	C. P. de la Motte	C. P. de la Motte	C. P. de la Motte	C. P. de la Motte	C. P. de la Motte
Chief Engineer	F. J. Gillies	F. J. Gillies	F. J. Gillies	F. J. Gillies	F. J. Gillies
2nd Engineer	H. Corner	H. Corner	A. Maxfield	A. Maxfield	M. Fritze
3rd Engineer	P. McArthur				
Cook	J. H. Rust[1], A. Fifoot,	J. Saliba	S.C. Dobbs	S.C. Dobbs	L. T. Kyme
Chief Steward	T. P. McMahon	O.F. Royall			C. Williams
2nd Steward	L. Pettit	D Whittle	C. Williams	C. Williams, S.E. Gibbon	H. V. Goddard
Sailmaker	J. Forbes	J. Forbes	J. Forbes	J. Forbes	
Donkeyman		H. Haugan			A. Beverley
Boatswain	D. T. Peers	E. L. Adams	E. L. Adams	E. L. Adams	J. Doherty
Able Seaman	E. L. Adams F. W. Desmond L. K. Joss B. L. McGrath O. W. McNeice A. Schroeder H. Wigzell	J. Doherty C. J. Hackworth B. C. Lincoln B.L. McGrath O. W. McNeice A. Schroeder L. Vinji	R. Bradley J. Doherty C. J. Hackworth B. C. Lincoln O. W. McNeice A. Schroeder L. Vinji	R. Bradley J. Doherty C. J. Hackworth B. C. Lincoln O. W. McNeice A. Schroeder G. Taylor L. Vinji	M. Foley J. Hansen T. R. A. Liddiard J. G. Mahr O. W. McNeice J. Offin
Stoker	H Coombe G. Crossley E. Dodds	A Dawson A. Kohler A. Thompson	A. Kohler S. G. R. Taylor A. Thompson	A. Kohler S. G. R. Taylor A. Thompson	E. Anderson J. Blake J. Mort

[1] Demoted to assistant cook when 'Jimmy' Fifoot signed on at Macquarie Island.

in New South Wales. True it would have been a rapid promotion from stoker in just a few years but promotional opportunities are greater in wartime! I was excited by the possibility that Gordon Reay Taylor was the *Aurora*'s man but would have been completely wrong when the family of Stanley Gordon Roberts Taylor (pl. 1) posted his Antarctic diary online (Gale 2011). In my defence there is no S for Stanley in the Captain's wages book but it does illustrate how easy it is to be led astray. Other clerical errors we know of include Sydney Clayton Dobbs who is recorded in the Captain's wages logbook as C.C. Dobbs. Sydney Clayton Dobbs applied for membership of the Antarctic Club in the 1950s on the strength of his service aboard *Aurora*.

While men with common names can prove to be difficult to trace the converse is true of men with unusual names and it only took two phone calls to contact the family of Cedric James Hackworth (pl. 2), who was listed as H. Hackworth in the Captain's wages book, and only one more to find the son of Laurence Thomas Kyme, cook, who was noted in the wages book as L.F. Kyme. These spelling inaccuracies are worrying and bring into question many of the other listings in the Captain's wages log. For example, do we have the correct spelling for J. G. Mahr or A. Schroeder and is the stoker on the third Antarctic voyage Enoch Anderson or Andersen? Sadly for 23 of the

PLATE 1 — Stanley Gordon Roberts Taylor, fireman on the second sub-Antarctic cruise and second Antarctic voyage. A large, powerful Australian whose service on board the *Aurora* only became apparent when his family posted his Antarctic diary online in 2011. Photo source: Taylor family.

PLATE 2 (above) — Cedric James Hackworth, AB, pictured here outside the Auckland Island refuge in 1912, went on to join the Union Steam Ship Company, gaining his Master's ticket in 1922. He subsequently served as a harbour pilot into Port Philip Bay and Melbourne. He is number 16 in plate 4. Photo source: Hackworth family.

PLATE 3 — James Forbes, who served as sailmaker on three Antarctic expeditions. He served on the Polar Star during the Dundee Whaling Expedition 1892–1893, on the Aurora 1911–1913 and with the Discovery Investigation on the RRS Discovery in 1925–27. He is number 13 in plate 4. Photo source: Photo by Frank Hurley, South Australia Museum, H99.

PLATE 4 — The crew of the *Aurora* – photograph taken by Les Hingo in Lyttelton sometime in late July/early August 1912. For identification of some of the numbered officers and men see text. Photo source: Australian Antarctic Division, The Crew at Lyttelton.

PLATE 5 — Albert Dawson, fireman on the first sub-Antarctic cruise in 1912. He was born in Salford on 30 August 1884 and saw service in the Merchant Navy during WW1. He is number 19 in plate 4. Photo source: Southampton City Council Archives CR10 478651.

PLATE 6 — Oliver Francis Royall, Chief Steward on the first sub-Antarctic cruise in 1912. Born in Southampton, England, on 31 May 1883, he married and settled in Australia and died in Sydney in 1949. He is number 17 in plate 4. Photo source: Southampton City Council Archives CR10 853323.

crew we have nothing more than a name against their role on board (Dartnall 2014).

Photographic images can be another useful source for the researcher. However, good identified photographs of the crew are rare and few are of the quality of the Frank Hurley photo (pl. 3) in which James Forbes is identified just as the sailmaker. As there was only one sailmaker aboard the *Aurora* during the AAE this photo must be of James Forbes (table 1) and confirmed by other named photographs (Dartnall 2008). James Forbes, who was born in Dundee in 1871, was described as 5'4" tall with blue eyes, dark hair and a fresh complexion. With service on three Antarctic expeditions it is disappointing that nothing further is known about him but illustrates just how difficult it is to find out much about these men 100 years after the voyages.

In none of the photos in the Coombe Collection (State Library of New South Wales) of the crew taken on Macquarie Island is anyone identified. They show men well wrapped up against the cold and often sporting beards and moustaches which are not of much help for spotting distinctive features. There is one particularly good crew photo in the Australian Antarctic Division's archives – taken at Lyttelton at the end of the First sub-Antarctic cruise (pl. 4). This was taken by Les Hingo, a professional photographer, and shows 19 of the crew of 22. While the names of the five officers – seated at the front and wearing peaked hats and collars and ties – are known, only four of the men are identifiable. In this photograph the lifebuoy is supported by Second Officer Percy Gray (number 1 in pl. 4). On his left is First Officer Frank Douglas Fletcher (number 2), then Chief Engineer Frederick Gillies is number 3, Second Engineer Harry Corner is number 4 and number 5 is Third Officer Clarence Peterson de la Motte. Of the rest I believe number 13 is the sailmaker James Forbes, number 16 is able seaman Cedric James Hackworth, number 17 is the steward Oliver Francis Royall and number 19 is fireman Albert Dawson.

Merchant Seamen's records, where they exist, are widely scattered (The National Archives, Kew, UK; Southampton City Council Archives; University of Newfoundland) and difficult to trace and interpret (see Watts & Watts 1991 for a guide). United Kingdom seamen carried Board of Trade identity cards complete with a head and shoulders photograph and details of when and where they were born (BT 348, 349, 350). Southampton City Council Archives maintains copies of these identity cards. An opportunistic cross-check yielded six hits including two seamen (pls 5 & 6) who served on the First sub-Antarctic cruise and both of these men, Dawson and Royall, can be identified in the crew photograph (pl. 4).

Not all seamen want to be found. It was not uncommon for young men to run away to sea, and for those with a dubious past to sign-on using an alias. At least one man served on *Aurora* under an alias but there is nothing suspicious in this case – Leon François William Pittet anglicised his name to Leonard Pettit – not a difficult one to fathom, but are there others?

One man, we know, did not want to be found, though this was long after the expedition had returned. Duncan Taylor

Peers, the boatswain on the First Antarctic Voyage, was dismissed after he gave an interview to *The Sun* newspaper (Riffenburgh 2011) criticising Captain John King Davis and alleging panic, poor seamanship and damage when the ship touched a submerged rock in Caroline Cove, Macquarie Island, in 1911. In 1930 Duncan Peers' second wife placed advertisements in the personal columns of *The Mercury* (a Tasmanian newspaper) seeking his whereabouts (*The Mercury* 1930). Presumably she had some inkling that he was there, but I don't believe she ever found him then so what chance do we have more than 80 years later?

Soon after the expedition ended, the First World War was declared and many members saw active service. Harry Corner, Albert Dawson (pl. 5), Sydney Clayton Dobbs, Leslie Keith George Joss, Joseph Offin and Oliver Francis Royall (pl. 6) served in the Merchant Navy and were awarded the British War Medal and the Mercantile Marine War Medal (BT 351).

Many other crew members joined the Australian Army (NAA B2455) and their attestation papers occasionally contain such additional information as "went to the south pole with Douglas Mawson" as well as giving details of their height, colour of hair and eyes and where tattooed. Among the men who volunteered was Abraham Fifoot, cook, who joined *Aurora* at Macquarie Island; he who knocked five years off his true age of 49 to enlist in 1915. Others who enlisted include Laurence Kyme and Thomas Percival McMahon. Herbert Victor Goddard (Quilty & Goddard 2004) received a gun-shot wound to the buttocks, and Cedric James Hackworth was wounded in the ankle. Harry Wigzell became a prisoner of war. Five of the crew – Harry Coombe, Frederick William Desmond, Bertrum Clive Lincoln, Leonard Pettit and David Whittle – paid the ultimate sacrifice and were killed in action (Dartnall 2014).

At least one other crew member met a violent death. Bernard Lawrence McGrath, then a gold prospector in New Guinea, was ambushed by local tribesmen and was shot and killed by arrows on 24 February 1934 (*The Sunday Sun* 1934).

Far too many of *Aurora*'s crew remain unknown. It is to be hoped that more will be uncovered as the families of these men come forward and from internet advances in genealogical research. The handling of *Aurora* by Captain John King Davis, his officers and crew was the key to the successful prosecution of the Australasian Antarctic Expedition. What they achieved under very trying conditions in uncharted waters and without modern electronic navigational aids and weather forecasts was quite magnificent. Truly the crew members are the unsung heroes of the expedition.

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THE COASTAL MARINE MOLLUSC FAUNA OF KING ISLAND, TASMANIA

by Simon Grove and Robert de Little

(with one text-figure, one plate, one table and an appendix)

Grove, S & de Little, R. 2014 (19:xii: The coastal marine mollusc fauna of King Island, Tasmania. *Papers and Proceedings of the Royal Society of Tasmania* 148: 17–42. ISSN 0080-4703. Rosny Collections and Research Facility, Tasmanian Museum and Art Gallery, GPO Box 1164, Hobart Tasmania 7001 Australia (SG*); PO Box 683, Port Arthur Tasmania 7182 Australia (RdL). *Author for correspondence. Email: simon.grove@tmag.tas.gov.au

The findings of a week-long survey of coastal marine molluscs around King Island are documented. In total, 408 species were recorded, 78 for the first time. King Island appears to be the only Tasmanian outpost for 44 species. Only two non-native species were found. A number of usually distinct species-pairs or groups appear to form intergrades around King Island. Along the island's east coast, beached shells belonging to Quaternary-era sub-fossils were found, not all of which are represented in the contemporary local fauna. Following critical examination of published sources and museum specimens, a checklist of King Island's coastal marine mollusc fauna is presented, comprising 619 species. It is likely that many more local species await discovery and documentation.

Key Words: Mollusca, King Island, Tasmania

INTRODUCTION

King Island sits in western Bass Strait at around 40°S and 144°E, and is a geographical outlier relative to the rest of Tasmania: it includes the westernmost shorelines in Tasmania, as well as some of the northernmost. Different parts of Tasmania host unique complements of coastal marine species, in part because of differing levels of influence of the various ocean currents that affect Tasmanian coastal waters, such as the Zeehan Current to the west and the East Australian Current to the east (e.g., Coleman *et al.* 2013). Indeed, Tasmania sits in a zone of overlap between three broad marine biogeographic provinces (Bennett & Pope 1960, Waters *et al.* 2010). These are known as the Flindersian (Perth to Port Phillip Bay), the Peronian (Port Phillip Bay to northern New South Wales, plus eastern Tasmania) and the Maugean (Tasmania, plus the coast of Victoria and eastern South Australia).

Because of its geographical position, King Island can be expected to host an unusual coastal marine mollusc fauna, showing more affinities with the Flindersian fauna than is typical for the rest of Tasmania. However, despite the past efforts of a number of recorders and collectors, the knowledge-base regarding King Island's coastal marine molluscs remains fragmentary. We sought to remedy this, through two approaches. First, we conducted a week-long collecting trip of our own, with the aim of compiling species lists for as many localities as feasible. Second, we undertook a critical examination of local museum and other specimens together with published and unpublished sources of information on the island's coastal marine molluscs. This paper brings together what we now know about the King Island fauna and places it in the context of that of the rest of Tasmania. These findings are then combined into an updated checklist (appendix 1).

METHODS

Field surveys and follow-up identification

Twenty-one discrete localities were surveyed during 13–19 March 2013, covering points around much of the island's coastline (table 1, fig. 1). Choice of localities was determined primarily by feasibility of access (by car and on foot), although in prioritising we also took into consideration the recommendations of local people and the origins of previous records. At each locality, we compiled as complete a collection of species as possible over the space of one to a few hours of searching, focusing primarily on beached shells but also incorporating records of any living molluscs found, e.g., on or under rocks or amongst seaweed. Although our collecting efforts were biased towards the larger species, we collected small samples (up to about 300 cm^3) of shell-grit from each locality at which we found sufficient accumulations. We only moved on to a new locality once we felt we had exhausted a given locality. We identified and recorded most of the larger specimens *in situ* or back at base, and compiled our records into a database while still on the island, allowing us to discard all but the most valuable specimens. Specimens that were harder to identify, including all micromolluscs, were brought back to Hobart and identified later. Sources of identification included the extensive collections at the Tasmanian Museum and Art Gallery (TMAG), web-sites (Beechey 2014, Grove 2014), unpublished compilations on southeast Australian marine gastropods (A. Monger, pers. comm.) and relevant publications such as Grove (2010), Huber (2010), Lamprell & Healy (1998), Lamprell & Whitehead (1992) and May & MacPherson (1958). Images of specimens that proved intractable were sent to other experts for identification or validation.

Retained shells currently reside with the authors but will ultimately be deposited in the Tasmanian Museum and Art Gallery collection; records will be sent to the online *Atlas of Living Australia*.

TABLE 1 — The localities surveyed during March 2013 visit to King Island

1. *Ettrick Beach 39.9922°S x 143.8876°E (13 March). A small beach on the exposed W coast. Rocky islets give a variety of aspects and exposures. Much bull-kelp debris strewn over boulders and pebbles. A small creek outflow gives rise to some areas of fine sediment.
2. Sandblow Bay, Grassy Harbour 40.0689°S x 144.0482°E (14 March). A steeply shelving beach of coarse sand on the SE coast, S of Grassy Harbour.
3. Grassy Harbour 40.0624°S x 144.0630°E (14 March). A series of sheltered, N-facing pebble coves immediately to the N of this SE-coast harbour.
4. City of Melbourne Bay 40.0086°S x 144.0020°E (14 March). A series of moderately exposed, E-facing beaches between low rocky outcrops. Much kelp debris over boulders and pebbles, and with areas of sand.
5. *Currie foreshore 39.9489°S x 143.8601°E (14 March). Exposed W-coast rocky coastline but with more sheltered pebble coves, S of the harbour.
6. *Fitzmaurice Bay 40.0618°S x 143.8816°E (15 March). Exposed W-coast rocky coastline but with rocky islets providing some shelter for pebble and sand coves, 1-3 km N of Fitzmaurice Beach.
7. Surprise Bay 40.1286°S x 143.9080°E (15 March). Gently sloping sandy beach with rocky outcrops and pebble-banks on exposed SW coast, afforded some shelter by adjacent headlands.
8. Gulchway, Stokes Point 40.1435°S x 143.9157°E (15 March). Series of steep, boulder and pebble beaches on exposed SW coast.
9. Black Point, Seal Bay 40.1125°S x 143.9676°E (15 and 19 March). Rocky headland and adjacent pebbly and sandy coves, on S coast.
10. Cape Wickham (foreshore to E) 39.5870°S x 143.9623°E (16 March). Exposed N-coast rocky coastline, with series of boulder and pebble beaches, 1-3 km E of Cape Wickham.
11. Disappointment Bay 39.6006°S x 143.9843°E (16 March). Gently sloping sandy beach between rocky headlands on exposed N coast, backed by low dunes.
12. Yellow Rock Beach, King Island 39.6280°S x 143.9324°E (16 March). Gently sloping sandy beach on NW coast, backed by dunes. Occasional rocky outcrops and a creek outflow.
13. Naracoopa foreshore 39.9166°S x 144.1179°E (17 March). Rocky reefs interspersed with coarse sand and pebble beaches; backed by cliffs at N end.
14. Blowhole, Sea Elephant Bay 39.8574°S x 144.1113°E (17 March). Accessible section of an extensive E-coast sandy beach, backed by wind-blown sand-flats and dunes.
15. Cowper Point, Sea Elephant Bay 39.8223°S x 144.1273°E (17 March). Accessible section of an extensive E-coast sandy beach backed by wind-blown sand-flats and dunes. Small rocky reef embedded in sand.
16. Lavinia Beach near Lake Martha Lavinia 39.6503°S x 144.0782°E (18 March). Accessible section of an extensive E-coast sandy beach, backed by wind-blown sand-flats and dunes.
17. Porky Beach 39.8479°S x 143.8602°E (18 March). Small sandy beach sheltered by rocky islands on otherwise exposed W-coast rocky shoreline. Much bull-kelp debris. Backed by low dunes.
18. *Little Porky Beach 39.8549°S x 143.8602°E (18 March). Small sandy beach sheltered by rocky islands on otherwise exposed W-coast rocky shoreline. Much bull-kelp debris. Backed by low dunes.
19. Red Hut Point 40.0991°S x 144.0005°E (19 March). Rocky headland and adjacent pebbly and sandy coves, on S coast.
20. *Colliers Beach 40.0985°S x 144.0005°E (19 March). Steeply sloping sandy beach between rocky headlands, on S coast.
21. *Seal Point 40.1107°S x 143.9779°E (19 March). Rocky headland and adjacent pebbly and sandy coves, on S coast.

Numbers correspond to those mapped on fig. 1.
* Localities from which shell-grit samples were collected.

Checklist compilation

We consulted five main published sources of information on King Island's coastal marine molluscs. Mulder (1902) lists (without specific locality information) species that he identified "from material brought from King's Island". May (1924) lists (mostly without specific locality information) the species that he collected on a visit to King Island (Grassy, Fraser – Sea Elephant Bay, Surprise Bay and Currie Harbour) in November 1922. Gabriel (1956) lists the species identified from adhering debris retrieved from a broken cable near Elephant Shoal Reef, four miles southeast of King Island in seven and a half fathoms of water. May & Macpherson (1958) illustrate a number of these species from Gabriel's and May's earlier King Island material, as well as some other species specifically noted as having been found around the island. A report on a field-trip to King Island in 1980 by the Marine Research Group (at the time affiliated to Museum Victoria) lists the live mollusc species encountered by locality; it is particularly informative in terms of the chitons and nudibranchs. The majority of species in these sources have since undergone name-changes as a result of taxonomic or nomenclatural revisions. We have not referred to these old names in our checklist; instead we have done our best to translate them into those in current usage.

Additionally, we extracted King Island records from the collections databases of the TMAG and the Queen Victoria Museum and Art Gallery. The TMAG records included some – but not all – of the King Island material cited and/or illustrated in May (1924) and May & MacPherson (1958); some of the shells collected during short visits to King Island by Devonport shell enthusiast Margaret Richmond in 1987 and by former TMAG curator Elizabeth Turner in 1990; and other assorted material from various collectors and donors. Margaret Richmond's personal collection records were also consulted by SG; her full collection is now at TMAG, and is in the process of being incorporated into the main collections. *The Atlas of Living Australia* (2014)

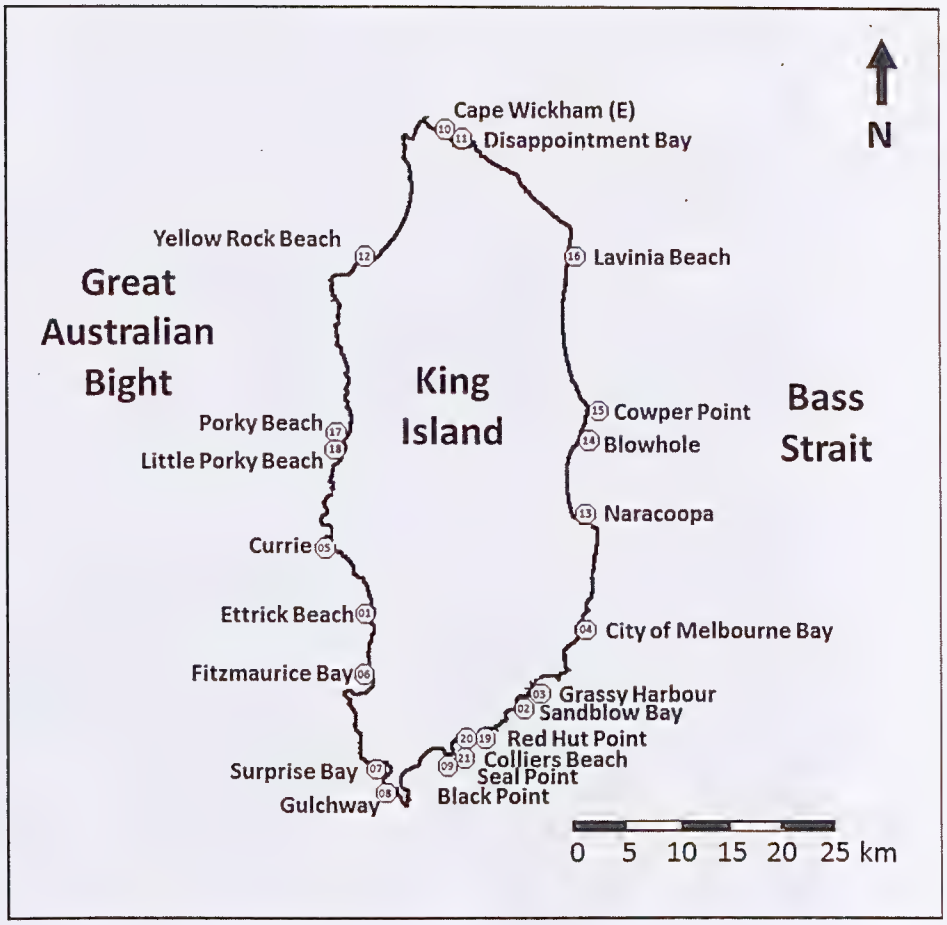

FIG. 1 — King Island, showing collecting localities from March 2013 visit. Numbers correspond to those used in table 1.

was consulted as a source of selected collection records only – primarily of species not otherwise documented from King Island and originating either from Museum Victoria or from the Australian Museum.

On King Island, we visited the King Island Museum in Currie, where much of the shell collection of the late Max McGarvie is displayed (further McGarvie material is held at TMAG). We were able to compare what was on display with a species-list given to SG by volunteer curator Margaret Batey, and to amend some of the identifications accordingly. Back in Hobart, SG viewed the King Island shell collection of Annabel and Peter Larkey, and incorporated records of species of particular interest. SG was also sent photos of shells collected on King Island during the 1970s by Jeannette Dennison, and later viewed some of the shells that she had collected then at Naracoopa. SG also received records of cowries collected on King Island since the 1990s by Hobart landsnail expert Dr Kevin Bonham.

All records from the above sources that were considered valid (as opposed to those arising through misidentifications, locality mix-ups or lack of taxonomic discrimination) were entered into a database maintained by SG, which was then queried in the process of producing the final checklist.

RESULTS

King Island's known coastal marine mollusc fauna, prior to our visit

We recognised valid pre-visit records for 541 species. These include 35 species for which we have no further Tasmanian records. Some of these may genuinely be restricted to King Island within the Tasmanian part of their range; others (particularly the chiton and nudibranchs) may simply be under-recorded elsewhere. The two chief sources of such records are Gabriel (1956) (14 species, all from Elephant Shoal Reef), and the Marine Research Group (1980) (14 species, primarily nudibranchs, various localities). These can be recognised in appendix 1 by the absence of other records for the species concerned. In taxonomic order, they are as follows: chitons – *Notoplax rubostriata*; bivalves – *Nuculana dohrni, Limopsis tenisoni, Limea austrina, Dacrydium radians, Salaputium micrum, Purpurocardia purpurata*; gastropods – *Macroschisma productum, Pterotrachea kingicola, Pisinna nitida, Socienna angasi, Paracuneus immaculatus, Mitromorpha bassiana, Mitromorpha macphersonae, Asperdaphne bastowi, Asperdaphne perplexa, Nepotilla lamellosa, Terebra albida, Aesopus gatliffi, Gibberula agapeta, Curveulima commensalis, Syrnola angasi, Melanochlamys queritor, Doto ostenta, Caldukia affinis, Rostanga crawfordi, Sclerodoris tarka, Doriopsilla miniata, Aphelodoris rossquicki, Neodoris chrysoderma, Onchidoris maugeansis, Paliolla cooki, Midorigai australis, Tamanovalva babai* and *Ascobulla fischeri*.

King Island's coastal marine mollusc fauna, based on our visit

We recorded 408 species of coastal marine mollusc. While most of our recorded species had been previously recorded from King Island, 78 comprise the first records of which we are aware. Our survey therefore brings the list up to 619 species. We present these in a taxonomically ordered checklist (appendix 1), in which our additions can be recognised by the absence of other records for the species concerned. Additionally, we found several micromollusc specimens that await formal identification, some of which do not match any described species. We make no further reference to these here.

Nine of our newly recorded species (pl. 1) join the 35 species mentioned earlier for which King Island appears to be their only Tasmanian outpost. All but one of our additions (the small topshell *Herpetopoma fenestratum*) are micromolluscs. One, a rice-shell, appears to be new to science: we refer to it here as *Merelina* sp. nov. A further undescribed rice-shell species, *Pisinna* sp. nov., is also known from Victorian waters and is awaiting description (L. Stephens, pers. comm.). Of the others, *H. fenestratum* and the wormshell *Stephopoma* cf. *nucleogranosum* are primarily "western" species otherwise found no closer to Tasmania than the coast of South Australia; while the caecid *Caecum amputatum*, the false-creeper *Specula regina*, the orbitestellids *Orbitestella bastowi* and *O.* cf. *decorata* and the pyramid-shell *Miralda montuosa* are all previously known from Victorian waters, and some are also known from adjacent mainland states.

Only two of our species are non-native – the screwshell *Maoricolpus roseus* and the oyster *Crassostrea gigas*; and our checklist contains no others, with the possible exception of *Mytilus galloprovincialis*, whose taxonomic and native status remains uncertain (Colgan & Middelfart 2011).

Species that we have removed from the King Island checklist

We identified past King Island records of 40 species that we feel do not belong on the list – and in some cases do not even belong on the Tasmanian list. We have determined that some of these represent suspected or confirmed past misidentifications, others locality mix-ups, and others a lack of taxonomic discrimination in the light of more recent species-splitting.

From Mulder (1902) we recognised many species as misidentifications on the basis of being well outside of their normal range; we were usually able to reassign these to local species. These include the butterfly-shell *Pteria physoides* (reassigned to *Electroma papilionacea*); the lucine clam *Myrtea fabula* (reassigned to *M. botanica*); the limpet *Patelloida saccharina* (to *P. alticostata*); the rice-shell *Rissoina spirata* (to *R. fasciata*); and the wentletrap *Epitonium aculeatum* (to. *E. minorum*). Mulder also claimed the North Atlantic bonnet-limpet *Hipponix antiquatus* (which we have reassigned to *Antisabia foliacea*). He recorded two Western Australian species: the limpet *Notoacmea conoidea* (reassigned to *N. corrodenda*); and the air-breather *Marinula patula* (to *M. xanthostoma*). Two of Mulder's records refer to species which occur in the region but which we have nevertheless reassigned to species more plausible for King Island: the lucine clam *Epicodakia consettiana* (to *E. tatei*, on the basis that the TMAG specimens from King Island also identified as *E. consettiana* proved on re-examination to be *E. tatei*); and the rice-shell *Merelina cheilostoma*, a species which has since been split, with "real" *M. cheilostoma* only likely to occur further east (reassigned to the newly described species, *M. cancellata*).

From May (1924) we reassigned the following records: the arc-shell *Destacar metella*, a species of NSW and eastern Victoria (assumed to be a juvenile *Barbatia pistachia*); *Lasaea miliaris*, a species of the western Atlantic and Antarctica (to *L. australis*); the topshell *Clanculus maugeri*, a species found in NSW and eastern Victoria (omitted, since May & MacPherson (1953) noted that the record "needs confirmation"); and the rice-shell *Merelina cheilostoma* (as above, reassigned to the newly described species, *M. cancellata*).

From Gabriel's (1956) list of the species identified from near Elephant Shoal Reef, we reassigned several species. Three of these are sinistral-creepers, which we reassigned to local species on the recommendation of the taxonomic expert for this group (L. Stephens, pers. comm.): the "eastern" *Aclophoropsis maculosa* (reassigned to *A. festiva*) and *Hedleytriphora innotabilis* (to *H. fasciata*), and the "western" *H. scitula* (also to *H. fasciata*). Gabriel also recorded the bubble-shell *Retusa pygmaea* (reassigned to *R. pelyx*, on the recommendation of the taxonomic expert for this group (R. Burn, pers. comm.).

From the Marine Research Group's (1980) list of live-found species we reassigned the "eastern" topshell *Ethminolia probabilis* to the more "western" *E. vitiliginea*.

From the King Island Museum's collection of shells donated by the late Max McGarvie, we deduced that some putative King Island specimens had in all probability been collected in Western Australia. Thus we discounted the museum's records of the warmer-water dog-whelk *Nassarius glans particeps* and also those of the warm-water dove-shell *Euplica bidentata*, a species for which purportedly King Island specimens had also been lodged by McGarvie at TMAG. We reassigned several other misidentified shells in the museum, as follows: the oyster *Saccostrea glomerata* (reassigned to *Ostrea angasi*), the pen-shell *Pinna bicolor* (to *Atrina tasmanica*), the kelp-snail *Phasianotrochus bellulus* (to *P. eximius*), the moon-snail *Conuber sordidus* (to *C. conicus*) and the rock-whelk *Sassia parkinsoniana* (to *S. subdistorta*). We have since worked with volunteers at the museum to correct errors.

From the TMAG's collections, we reidentified and reassigned the following: the notch-limpet *Emarginula superba* (to *E. dilecta*); the slit-shell *Puncturella kesteveni* (to *P. harrissoni*); the rice-shell *Onoba agnewi* (to *Alvania fasciata*); the limpet-like shell *Phenacolepas calva* (to *Asteracmea stowae*); the urchin-snail *Eulima lodderae* (to *Leiostraca kilcundae*); and the bubble-shell *Tornatina exserta* (to *T. apicina*). The specimen behind a TMAG record of the keyhole-limpet *Amblychilepas crucis* could not be located;

PLATE 1 — Specimens from March 2013 visit representing the nine coastal marine mollusc species considered new for Tasmania. 1: *Herpetopoma fenestratum*; 2: *Stephopoma* cf. *nucleogranosum*; 3: *Caecum amputatum*; 4: *Merelina* sp. nov.; 5: *Pisinna* sp. nov.; 6: *Specula regina*; 7: *Orbitestella bastowi*; 8: *Orbitestella* cf. *decorata*; 9: *Miralda montuosa*.

since *A. crucis* is currently considered to refer merely to juveniles of other *Amblychilepas* species, we provisionally reassigned the record to *A. nigrita*. Other species for which the TMAG specimens could not be located, and which we therefore considered to be dubious records for King Island given their normal range, were the top-shell *Danilia telebathia*, the false top-shell *Cirsonella carinata*, and the screw-shell *Colpospira atkinsoni*. The TMAG holds the holotype of *Turbo cucullata* Tenison Woods, 1878, based on a specimen collected by William Legrand, purportedly from "King's Island, Bass Strait". On examining the holotype, SG reassigned the specimen to *Turbo (Marmarostoma) bruneus*, whose normal range is the tropical Indo-Pacific. We have omitted it from our checklist on the assumption that the specimen concerned was mislocalised.

From *The Atlas of Living Australia* (2014) we excluded the warmer-water moon-snail *Conuber incei* (which we also found during our survey, but only as a sub-fossil); we reassigned the warmer-water moon-snail *Tanea euzona* to the cooler-water *T. sagittata*, and reassigned the eastern thickshell clam *Talabrica fulvida* to the more western *T. aurora*.

Doubtful species that remain on the King Island checklist

We found records of several further species whose presence around King Island remains in doubt, although we did not feel justified in removing them from our checklist. There are several species illustrated in May & Macpherson (1958) that are accompanied by text implying that the species had been found around King Island, despite their apparent absence from the rest of Tasmania. For four of these – the lucine clam *Callucina lacteola*, the topshell *Astele rubiginosa*, the doveshell *Aesopus plurisulcatus* and the auger shell *Terebra albida* – we have not been able to trace extant King Island specimens and can neither confirm nor refute their King Island status: all seem at least feasible. In a similar vein, there is a TMAG record of the widespread sheltered-water wedge-shell *Atactodea cuneata*; however, the specimen could not be located. TMAG also holds the specimens behind the only King Island records of two species of margin-shell. The specimen recorded as *Dentimargo dentiens* is referable to a broken specimen, which is not identifiable to species: it could be this species (since it is within range), or it could equally be the similar *Serrata mustelina*, which we found at several localities during our survey. Those specimens recorded as *Ovaginella ovum* were redetermined by SG as *O. pisum*. However, *Ovaginella ovum* was also claimed for King Island by Mulder (1902), a record which can be neither validated nor dismissed. The presence of three species of *Phasianotrochus* kelp-snail around King Island also remains in doubt. The Marine Research Group (1980) recorded *P. apicinus*, but we suspect a misidentification, perhaps of *P. irisodontes* or *P. eximius*. A record of *P. bellulus* from the Queen Victoria Museum and Art Gallery may refer to *P. eximius*, as was the case with the putative specimen of this species in the King Island Museum that we examined. However, the occurrence of both these additional *Phasianotrochus* species around King Island remains a possibility. Margaret Richmond claimed *P. rutilis* from Naracoopa. We did not find any shells on King Island fitting the supposed characters of *P. rutilis*; however, the species is within range and we have retained the record. The Marine Research Group (1980) and Mulder (1902) both claimed the limpet *Cellana tramoserica*. This species seems to be very rare in Tasmania, and the few other Tasmanian records are all referable to the far northeast of the state. However, *C. tramoserica* is common along the Bass Strait coast of Victoria, so its occurrence around King Island remains a possibility despite not being noted during our survey. There are many apparent records of the doveshell *Pyreneola lurida* from around Tasmania, including King Island, but these may refer to some other, perhaps undescribed, species since *P. lurida* otherwise is thought to occur no closer than about Sydney. Finally, Gabriel (1956) claimed the slit-shell *Anatoma australis* from Elephant Shoal Reef; this record could equally refer to the more recently described *A. tobeyoides*.

DISCUSSION

While our survey total of 408 species of coastal marine mollusc represents a substantial number, we recognise that serendipity played a big part in our finds: our survey is far from complete for a southern temperate coastline replete with nearshore reefs interspersed with sandy and gravelly seabeds that would be expected to provide habitat for a wide range of coastal marine molluscs. Several factors militated against more comprehensive coverage. First, no single week of survey effort could be otherwise, relative to the magnitude of the task at hand. Second, our own expertise did not permit a fuller survey of non-shelled molluscs. Third, not all parts of the coast were accessible to us. But beyond this, we found that intense wave-action and the high tidal range around King Island militated against the accumulation of intact beached shells or shell-grit except in a few favoured spots – though broken shells and shell fragments were much more widespread. Most of King Island's shorelines are exposed – its west coast in particular bears the full brunt of the Roaring Forties – and most beaches are steeply shelving, offering relatively little living-space for intertidal molluscs. Rocky shores were found to largely lack large intertidal macroalgae, which are normally rich habitat for molluscs, though bull kelp and other species were abundant in the sublittoral, and the strandline was often strewn with rotting kelp. There was a near-absence of in-shore seagrass beds and sheltered, estuarine environments – both key habitats for molluscs.

In total, 78 of the species that we recorded in our week-long survey comprise the first King Island records that we are aware of; nine of our newly recorded species join 35 others for which King Island appears to be their only Tasmanian outpost; two appear to be undescribed. The bivalve *Gomphinella undulosa* and the keyhole-limpet *Amblychilepas oblonga* are effectively confined to King Island in the Tasmanian part of their range, although we found them to be locally common around the island. Other species that were notable for being relatively common around King Island in comparison to elsewhere around Tasmania include the bivalves *Tucetona flabellata*, *Gari kenyoniana* and *Dosinia crocea*, and the gastropods *Phasianella ventricosa*, *Cabestana tabulata* and *Haustrum baileyanum*. Conversely, we were surprised not to find a number of species that are common elsewhere in Tasmania, and to find that others were relatively rare. For instance, our survey produced the first records of snakeskin chiton *Sypharochiton pelliserpentis*, a species which is abundant on rocky shores elsewhere in Tasmania. The mussels *Xenostrobus pulex* and *Austromytilus rostratus* – often dominant species on Tasmanian rocky shores – were almost absent, and we failed to find any specimens of blue mussel *Mytilus galloprovincialis*, although there is a single previous record of this species (whose native status is open to question, as mentioned above) from Grassy Harbour. Other species that were unusually scarce include the bivalves *Glycymeris striatularis*, *Dosinia caerulea* and *Gari livida* and the gastropods *Phasianella australis*, *Amblychilepas javanicensis*, *Phasianotrochus irisodontes*, *Conuber conicus*, *Cabestana spengleri* and *Agnewia tritoniformis*. We also failed to find any specimens of the

normally common topshell *Austrocochlea porcata*, although SG has been shown a photograph of a single shell of this species from Naracoopa. Writing of his shell-collecting visit to King Island, May (1924) similarly remarked that "the most remarkable feature was the absence of many common Tasmanian shells, particularly the larger bivalves".

We remain unable to account for most of these faunal differences between King Island and the rest of Tasmania, other than to invoke a general role for water-temperature, exposure and prevailing currents. However, two of our additions (the topshell *H. fenestratum* and the wormshell *Stephopoma* cf. *nucleogranosum*) are primarily "western" species otherwise found no closer than the coast of South Australia. Their presence probably reflects the strong influence around King Island of the southwards-flowing Zeehan Current (Cresswell 2000) which has its origins in the warmwater Leeuwin Current of Western Australia via a series of eddies that cross the Great Australian Bight (Ridgway & Condie 2004). Most other additions, and most of the other species for which King Island is their only Tasmanian outpost, are also known from Victoria as well as adjacent mainland states. Presumably, conditions around King Island remain sufficiently favourable year-round (in terms of water temperatures) for these more northern species, whereas conditions elsewhere in Tasmania do not. The same probably applies to the several species that we found to be common around King Island relative to their status elsewhere in Tasmania.

All but one of those species new to Tasmania are microscopic species identified from samples of shell-grit, and thus readily overlooked. However, over half of those new to King Island were larger than this, and hence potentially recordable by a wider range of beach visitors. That we were able to add so many species to the list is therefore an indication both of the gappiness in the knowledge-base concerning Tasmania's marine mollusc fauna, and of the rapid rate at which that knowledge-base is now improving, particularly with respect to micromolluscs and offshore species (e.g., de Little & Grove 2013, Stephens & Vafiadis 2013). This survey provides further impetus for updating the checklist of Grove *et al.* (2006), a task that is now in progress.

Only two (or, at most, three) of our finds represent non-native species, and the checklist contains no others. For one of these, *Mytilus galloprovincialis,* its taxonomic and native status remains uncertain locally, because some Australian populations bear the genetic signature of both native and European ancestry (Colgan & Middelfart 2011). Overall, three species represents a small proportion of the feral species pool in Tasmanian waters, which comprises at least ten shelled species and four nudibranchs (Grove 2014). This situation no doubt reflects King Island's remoteness from the original sources of introduction, which are mostly in the vicinity of Hobart, Launceston and Devonport, or across Bass Strait in Port Philip Bay (e.g., Whitehead 2008). The apparent scarcity of even these two feral species around King Island – and, for *Maoricolpus roseus*, the fact that ours were the first documented records – may suggest that they are recent arrivals, in which case we might expect their populations to follow similar trajectories of increase as has occurred elsewhere in Tasmania, where living animals and dead shells of feral species can at times dominate the sea-floor and vastly outnumber their native congeners (Probst & Crawford 2008, Whitehead 2008).

A number of species-pairs or groups whose individual species are quite well defined elsewhere in Tasmania appear to form intergrades or hybrid swarms around King Island. For instance, we noted apparent intergrades among the cowries *Notocypraea comptoni*, *N. declivis* and *N. piperita*, and between the keyhole-limpets *Amblychilepas nigrita* and *A. oblonga* (the latter species does not occur elsewhere in Tasmania). We also observed apparent intergrades between the nutmeg-shells *Cancellaria lactea* and *C. spirata,* and between *C. granosa* and *C. undulata.* Interestingly, we did not notice any apparent intergrades between *C. lactea* and *C. granosa,* though these can be found in eastern Tasmania. These putative intergrades may reflect a process of incomplete speciation having its origins in the various climatic upheavals of the Pleistocene. Fluctuating temperature regimes and sea-levels during this era would have alternately separated and then reunited sibling populations to the east and west of what is currently Bass Strait but which has in the past formed the so-called Bassian Isthmus connecting Tasmania to mainland Australia (Ayre *et al.* 2008, Colgan & Costa 2013, Li *et al.* 2013, Waters 2008, Waters *et al.* 2010). The most recent isthmus is thought to have bridged eastern Bass Strait. Nevertheless, King Island may sit more firmly than other parts of Tasmania in a zone of re-contact between incompletely segregated sibling taxa to the east and west. However, testing this conjecture would require extensive molecular sampling of live-caught material from throughout the species' ranges.

The Pleistocene upheavals have also left their biological signature in the sediments that have accumulated on King Island's land-surface and nearshore marine environments (D'Costa *et al.* 2006). Along the east coast, particularly at Naracoopa, we identified beached shells that appear to be Quaternary-era sub-fossils, not all of which are referable to species represented in the contemporary local fauna. For instance, the moon-snail *Conuber incei* is considered a warmer-water species that is not currently found south of Victoria; the cowrie *Umbilia hesitata* and the rock-whelk *Sassia epitrema*, are today confined in Bass Strait to much deeper waters; and the kelp-snail *Bankivia fasciata* and the nutmeg-shell *Cancellaria purpuriformis* still occur locally but apparently very rarely, though they are not uncommon elsewhere in Tasmanian nearshore waters. Together, these records are noteworthy in that they demonstrate the changing nature of the local fauna; they are also a reminder that not all shells on a beach are necessarily derived from locally extant populations.

CONCLUSION

Taken together, our survey, recording and compilation efforts demonstrate that King Island supports a rich and unusual coastal marine mollusc fauna in a Tasmanian context. Despite

our best efforts at identifying specimens and validating previous records, it is likely that some of the species on our checklist represent misidentifications; while it is equally likely that additional species should rightly appear on the list. Continued developments in taxonomy, systematics and nomenclature are further reasons why this checklist will one day be considered obsolete. In the meantime, it provides a firm base on which future researchers and enthusiasts can build.

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APPENDIX 1

A systematic checklist of the coastal marine molluscs of King Island, annotated with record sources and localities.

Record localities and their geographic coordinates

Note: whereas the coordinates accompanying the locality names are provided at a standard level of precision, the level of accuracy of those coordinates varies depending on the source information.

Bass Strait NE of KI, scallop survey site 01 (39.5200°S × 144.0800°E); Bass Strait NE of KI, scallop survey site 02 (39.5200°S × 144.0800°E); Bass Strait NE of KI, scallop survey site 04 (39.5400°S × 144.1500°E); Bass Strait NE of KI, scallop survey site 05 (39.5300°S × 144.1800°E); Bass Strait NE of KI, scallop survey site 08 (39.4900°S × 144.1400°E); Bass Strait NE of KI, scallop survey site 11 (39.5600°S × 144.1900°E); Bass Strait NE of KI, scallop survey site 42 (39.4400°S × 144.4900°E); Black Point, Seal Bay (40.1125°S × 144.1273°E); Blowhole, Sea Elephant Bay (39.8574°S × 144.1113°E); Boulder Point (39.6254°S × 144.0520°E); British Admiral Beach (39.9549°S × 143.8661°E); Cape Wickham (foreshore to E) (39.5870°S × 143.9623°E); Cape Wickham (unlocalised) (39.6042°S × 143.9577°E); Cataraqui Point (40.0627°S × 143.8586°E); City of Melbourne Bay (40.0086°S × 144.0020°E); Colliers Beach (40.0985°S × 144.0005°E); Cooper Bluff (39.7021°S × 143.8728°E); Cowper Point, Sea Elephant Bay (39.8223°S × 144.1273°E); Currie Harbour (39.9270°S × 143.8446°E); Disappointment Bay (39.6006°S × 143.9843°E); East coast of KI (unlocalised) (39.9121°S × 144.1103°E); Elephant Shoal Reef (40.1380°S × 144.0810°E); Ettrick Beach (39.9922°S × 143.8876°E); Fitzmaurice Bay (40.0618°S × 143.8816°E); Foreshore S of Currie (39.9489°S × 143.8601°E); Fraser Beach (unlocalised) (39.9121°S × 144.1103°E); Grassy (unlocalised) (40.0615°S × 144.0630°E); Grassy Harbour (40.0624°S × 144.0630°E); Gulchway, Stokes Point (40.1435°S × 143.9157°E); Halfmoon Bay (39.9489°S × 143.8601°E); KI (offshore, unlocalised) (39.6510°S × 144.0780°E); KI (unlocalised) (39.9270°S × 143.8446°E); Lavinia Beach (unlocalised) (39.6503°S × 144.0782°E); Lavinia Beach near Lake Martha Lavinia (39.6503°S × 144.0782°E); Little Porky Beach (39.8549°S × 143.8602°E); Naracoopa foreshore (39.9166°S × 144.1179°E); Pass River Bay (39.8010°S × 143.8648°E); Porky Beach (39.8479°S × 143.8602°E); Red Hut Point (40.0991°S × 144.0005°E); Sandblow Bay, Grassy Harbour (40.0689°S × 144.0482°E); Sea Elephant Beach (unlocalised) (39.8785°S × 144.1047°E); Sea Elephant Lagoon (39.8209°S × 144.11281°E); Seal Point (40.1107°S × 143.9779°E); South coast of KI (unlocalised) (40.1243°S × 143.9043°E); Surprise Bay (40.1286°S × 143.908°E); Unlucky Bay (39.8228°S × 143.8616°E); Victoria Cove (39.5951°S × 143.9344°E); West coast of KI (unlocalised) (39.927°S × 143.8446°E); Yellow Rock Beach (39.628°S × 143.9324°E).

Record sources and their acronyms

Australian Museum, via *Atlas of Living Australia* (AMS); Annabel and Peter Larkey (APL); Gabriel (1956) (CJG); Jeannette Dennison (JD); Mulder (1902) (JFM); Kevin J. Bonham (KJB); King Island Museum (KIM); Margaret H. Richmond (MHR); Marine Research Group (MRG); May & McPherson (1953) (MAM); Museum Victoria, via *Atlas of Living Australia* (MV); Queen Victoria Museum and Art Gallery (QVMAG); Simon J. Grove, Ben U. Grove and Robert de Little, March 2013 (SGRDL); Tasmanian Museum and Art Gallery (TMAG); May (1924) (WLM).

Systematic list

Broadly speaking, this checklist follows a well-established taxonomic order for molluscan families that is relatively stable. However, other than class, higher taxonomic rankings are omitted, partly because these are in a constant state of flux.

POLYPLACOPHORA

Acanthochitonidae

Acanthochitona bednalli (Pilsbry, 1894): Elephant Shoal Reef (CJG)

Acanthochitona granostriatus (Pilsbry, 1894): Fraser Bch (unlocalised) (QVMAG)

Acanthochitona kimberi (Torr, 1912): KI (unlocalised) (WLM)

Acanthochitona sueurii (Blainville, 1825): Currie Hbr (QVMAG); Grassy Hbr (MRG); KI (unlocalised) (WLM); Naracoopa (MRG); Surprise Bay (MRG)

Craspedochiton variabilis (A. Adams & Angas, 1864): KI (unlocalised) (WLM)

Notoplax costata (A. Adams & Angas, 1864): KI (unlocalised) (MV, WLM)

Notoplax rubrostrata (Torr, 1912): Currie Hbr (MRG)

Cryptoplacidae

Cryptoplax striata (Lamarck, 1819): Currie Hbr (MRG); KI (unlocalised) (QVMAG, WLM); Naracoopa (MRG); Surprise Bay (MRG); Victoria Cove (MRG)

Chitonidae

Rhyssoplax calliozona (Pilsbry, 1894): Elephant Shoal Reef (CJG); KI (unlocalised) (TMAG)

Rhyssoplax diaphora (Iredale & May, 1916): Currie Hbr (MRG); Grassy Hbr (MRG)

Rhyssoplax tricostalis Pilsbry, 1894: Elephant Shoal Reef (CJG)

Sypharochiton pelliserpentis (Quoy & Gaimard, 1836): Lavinia Bch (SGRDL); Naracoopa (SGRDL)

Ischnochitonidae

Callistochiton antiquus (Reeve, 1847): Currie Hbr (MRG); KI (unlocalised) (WLM)

Callochiton crocinus (Reeve, 1847): Currie Hbr (MRG)

Ischnochiton australis (Blainville, 1825): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL, MRG); KI (unlocalised) (WLM); Naracoopa (SGRDL, MRG); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (MRG)

Ischnochiton cariosus (Pilsbry, 1892): Ettrick Bch (MRG); Naracoopa (MRG)

Ischnochiton elongatus (Blainville, 1825): Currie Hbr (MRG); Grassy Hbr (MRG); Naracoopa (MRG)

Ischnochiton lineolatus (Blainville, 1825): KI (unlocalised) (WLM)

Ischnochiton smaragdinus (Angas, 1867): KI (unlocalised) (WLM)

Ischnochiton subviridis (Iredale & May, 1916): Fraser Bch (unlocalised) (QVMAG); KI (unlocalised) (WLM)

Ischnochiton variegatus (H. Adams & Angas, 1864): Ettrick Bch (MRG); Grassy Hbr (MRG); KI (unlocalised) (WLM); Surprise Bay (MRG); Victoria Cove (MRG)

Ischnochiton versicolor (Sowerby, 1840): Ettrick Bch (MRG); Grassy Hbr (MRG); Naracoopa (MRG); Surprise Bay (MRG)

Ischnochiton virgatus (Reeve, 1848): KI (unlocalised) (WLM)

Mopaliidae

Plaxiphora albida (Blainville, 1825): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); KI (unlocalised) (WLM); Naracoopa (SGRDL, MRG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (MRG); Victoria Cove (MRG)

Plaxiphora matthewsi (Iredale, 1910): KI (unlocalised) (WLM)

Lepidopleuridae

Leptochiton badius (Hedley & Hull, 1909): Currie Hbr (MRG)

Leptochiton matthewsianus (Bednall, 1906): Currie Hbr (MRG)

BIVALVIA

Nuculanidae

Nuculana dohrni (Hanley, 1861): Elephant Shoal Reef (CJG)

Nuculidae

Ennucula obliqua (Lamarck, 1819): KI (unlocalised) (JFM)

Pronucula pusilla (Angas, 1877): Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL); Surprise Bay (SGRDL)

Solemyidae

Solemya velesiana Iredale, 1931: Ettrick Bch (SGRDL)

Arcidae

Acar squamosa (Lamarck, 1819): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)

Barbatia pistachia (Lamarck, 1819): Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Grassy Hbr (SGRDL, MRG); Lavinia Bch (SGRDL, KIM); Naracoopa (SGRDL, MHR); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Glycymerididae

Glycymeris mayi Cotton, 1947: Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Naracoopa (SGRDL, TMAG)

Glycymeris striatularis (Lamarck, 1819): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG, MHR); Sandblow Bay, Grassy Hbr (SGRDL); Yellow Rock Bch (SGRDL)

Tucetona flabellata (Tenison Woods, 1877): Blowhole, Sea Elephant Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Elephant Shoal Reef (CJG); KI (unlocalised) (WLM); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Limopsidae

Limopsis tenisoni Tenison Woods, 1878: Elephant Shoal Reef (CJG)

Lissarca rhomboidalis Verco, 1907: Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)

Lissarca rubricata (Tate, 1886): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); Seal Pt (SGRDL)

Philobryidae

Cosa fibriata Tate, 1898: Fitzmaurice Bay (TMAG)

Lissarca rubricata (Tate, 1886): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Seal Pt (SGRDL)

Philobrya crenatulifera (Tate, 1892): Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Fraser Bch (unlocalised) (TMAG); Grassy Hbr (MRG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM); Lt Porky Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)

Philobrya rubra (Hedley, 1904): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Naracoopa (TMAG, MHR, MRG); Seal Pt (SGRDL)

Limidae

Lima nimbifer Iredale, 1924: Fitzmaurice Bay (SGRDL); S coast of KI (unlocalised) (TMAG)

Limatula strangei (Sowerby, 1872): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Yellow Rock Bch (TMAG, MHR)

Limea austrina (E. A. Smith, 1891): KI (unlocalised) (AMS); Naracoopa (JD)

Mytilidae

Austromytilus rostratus (Dunker, 1857): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cooper Bluff (MRG); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (QVMAG, WLM); Lavinia Bch (SGRDL, MHR); Naracoopa (SGRDL); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (TMAG, MHR)

Brachidontes erosus (Lamarck, 1819): Ettrick Bch (SGRDL); KI (unlocalised) (QVMAG); Yellow Rock Bch (TMAG, MHR)

Dacrydium radians Suter, 1908: Elephant Shoal Reef (CJG)

Gibbomodiola albicostata Lamarck, 1819: Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (MRG); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL, MHR); Naracoopa (MRG); Yellow Rock Bch (MHR)

Gregariella barbata (Reeve, 1858): Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Seal Pt (SGRDL)

Modiolus areolatus Gould, 1850: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Musculus impactus (Hermann, 1782): C Wickham (E) (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Mytilus galloprovincialis Lamarck, 1819: Grassy Hbr (MRG)

Xenostrobus pulex (Lamarck, 1819): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); Halfmoon Bay (TMAG, MHR); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MRG); Pass R Bay (TMAG); Seal Pt (SGRDL); Victoria Cove (MRG)

Ostreidae

Crassostrea gigas (Thunberg, 1793): Naracoopa (TMAG, MHR); Yellow Rock Bch (SGRDL)

Ostrea angasi Sowerby, 1871: Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Grassy Hbr (MRG); KI (unlocalised) (KIM, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, MHR); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Pectinidae

Equichlamys bifrons (Lamarck, 1819): Yellow Rock Bch (MHR)

Mimachlamys asperrima (Lamarck, 1819): Bass Strait NE of KI, scallop survey site 01 (TMAG); Blowhole, Sea Elephant Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Grassy (unlocalised) (TMAG); KI (unlocalised) (JFM, KIM, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Notochlamys hexactes (Lamarck, 1819): Lavinia Bch (SGRDL, MHR); Yellow Rock Bch (SGRDL)

Pecten fumatus Reeve, 1852: Bass Strait NE of KI, scallop survey site

01 (TMAG); Blowhole, Sea Elephant Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); KI (unlocalised) (KIM, WLM); Lavinia Bch (SGRDL, MHR); Naracoopa (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Semipallium aktinos (Petterd, 1886): Elephant Shoal Reef (CJG); Grassy Hbr (SGRDL); KI (unlocalised) (KIM); Yellow Rock Bch (TMAG)

Talochlamys pulleineana (Tate, 1887): Elephant Shoal Reef (CJG)

Propeamussiidae

Cyclochlamys favus Hedley, 1902: Elephant Shoal Reef (CJG)

Pinnidae

Atrina tasmanica (Tenison Woods, 1876): Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (KIM); Lavinia Bch (SGRDL, MHR)

Vulsellidae

Electroma papilionacea (Lamarck, 1819): Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL); KI (unlocalised) (JFM); Naracoopa (KIM)

Vulsella ovata Lamarck, 1819: C Wickham (E) (SGRDL); Grassy Hbr (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (TMAG, MHR)

Trigoniidae

Neotrigonia margaritacea (Lamarck, 1804) / *N. bednalli* (Verco, 1907) (species boundary uncertain): Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); KI (unlocalised) (QVMAG, WLM); Lavinia Bch (SGRDL, MHR, KIM); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Hiatellidae

Hiatella australis (Lamarck, 1818): Black Pt, Seal Bay (SGRDL); Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); W coast of KI (unlocalised) (TMAG)

Panopea australis Sowerby, 1833: Cowper Pt, Sea Elephant Bay (SGRDL); Lavinia Bch (SGRDL); Yellow Rock Bch (MHR)

Pholadidae

Barnea australasiae Sowerby, 1849: Naracoopa (TMAG, KIM)

Barnea obturamentum Hedley, 1893: Colliers Bch (SGRDL); Grassy (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR, KIM)

Clavagellidae

Humphreyia strangei (A. Adams, 1852): Naracoopa (SGRDL)

Cuspidariidae

Pseudoneaera tasmanica (Tenison Woods, 1876): Elephant Shoal Reef (CJG)

Cleidothaeridae

Cleidothaerus albidus (Lamarck, 1819): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); Boulder Pt (MHR); C Wickham (E) (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Grassy (unlocalised) (TMAG); Lavinia Bch (SGRDL); Naracoopa (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Myochamidae

Myadora brevis Sowerby, 1829: Colliers Bch (SGRDL); Lavinia Bch (TMAG, MHR); Yellow Rock Bch (TMAG, MHR)

Myadora complexa Iredale, 1924: Black Pt, Seal Bay (SGRDL); Colliers Bch (SGRDL); Lavinia Bch (SGRDL)

Myadora rotundata Sowerby, 1875: Colliers Bch (SGRDL)

Myochama anomioides Stutchbury, 1830: KI (unlocalised) (WLM)

Laternulidae

Laternula tasmanica Reeve, 1863: Yellow Rock Bch (SGRDL)

Thraciidae

Thraciopsis peroniana Iredale, 1924: Colliers Bch (SGRDL)

Cardiidae

Acrosterigma cygnorum (Deshayes, 1855): Fitzmaurice Bay (TMAG); Lavinia Bch (SGRDL); S coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Fulvia tenuicostata (Lamarck, 1819): Blowhole, Sea Elephant Bay (SGRDL); Colliers Bch (SGRDL); Disappointment Bay (SGRDL); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Nemocardium thetidis (Hedley, 1902): Elephant Shoal Reef (CJG); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Carditidae

Cardita aviculina Lamarck, 1819: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Naracoopa (SGRDL); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL)

Centrocardita rosulenta (Tate, 1887): Colliers Bch (SGRDL)

Purpurocardia amabilis (Deshayes, 1854): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); KI (unlocalised) (WLM); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG)

Purpurocardia bimaculata (Deshayes, 1854): Elephant Shoal Reef (CJG); Lavinia Bch (SGRDL); Naracoopa (MHR)

Purpurocardia columnaria Hedley & May, 1908: Elephant Shoal Reef (CJG)

Purpurocardia purpurata (Deshayes, 1854): Elephant Shoal Reef (CJG)

Vimentum dilectum (E.A. Smith, 1885): Elephant Shoal Reef (CJG)

Condylocardiidae

Carditella jaffaensis (Cotton & Godfrey, 1938): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (MRG)

Carditellopsis elegantula (Tate & May, 1901): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)

Condylocardia limaeformis Cotton, 1930: Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL)

Condylocardia notoaustralis Cotton, 1930: Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)

Condylocardia pectinata (Tate & May, 1900): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG); KI (unlocalised) (JFM); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)

Condylocardia rectangularis Cotton, 1930: Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR); Lt Porky Bch (SGRDL)

Condylocuna projecta (Hedley, 1902): Fitzmaurice Bay (TMAG); Seal Pt (SGRDL)

Cuna concentrica Hedley, 1902: Colliers Bch (SGRDL); Fitzmaurice Bay (TMAG); Seal Pt (SGRDL)

Cunanax subradiata (Tate, 1889): Elephant Shoal Reef (CJG)

Cuna delta (Tate & May, 1900): Seal Pt (SGRDL)

Hamacuna hamata (Hedley & May, 1908): Elephant Shoal Reef (CJG)

Ovacuna atkinsoni (Tenison Woods, 1877): Fitzmaurice Bay (SGRDL)

Propecuna obliquissima (Tate, 1887): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG)

Crassatellidae
Eucrassatella kingicola (Lamarck, 1805): C Wickham (E) (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (TMAG); Lavinia Bch (SGRDL, MHR, KIM); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (MHR)
Salaputium micrum (Verco, 1895): Elephant Shoal Reef (CJG)
Talabrica aurora (A. Adams & Angas, 1864): Elephant Shoal Reef (CJG); KI (unlocalised) (AMS)

Basterotiidae
Basterotia subalata (Gatliff & Gabriel, 1910): Lt Porky Bch (SGRDL)

Cyamiidae
Cyamium communis Hedley, 1906: Colliers Bch (SGRDL); Fitzmaurice Bay (TMAG); Seal Pt (SGRDL)
Gaimardia rostellata (Tate, 1889): KI (unlocalised) (JFM)
Gaimardia tasmanica (Beddome, 1882): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (TMAG); Lt Porky Bch (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG)
Reloncavia mactroides Tate & May, 1900: Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)

Neoleptonidae
Neolepton planiliratum (Gatliff & Gabriel, 1911): Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (MRG); Lt Porky Bch (SGRDL); Naracoopa (MRG); Seal Pt (SGRDL)

Galeommatidae
Arthritica helmsi Heldey, 1915: Sea Elephant Lagoon (MRG)
Borniola radiata (Hedley, 1905): Fitzmaurice Bay (TMAG)
Kellia rotunda (Deshayes, 1855): Elephant Shoal Reef (CJG)
Lasaea australis (Lamarck, 1818): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG)
Lepton trigonale Tate, 1879: Colliers Bch (SGRDL); Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL)
Marikellia solida (Angas, 1877): Grassy Hbr (SGRDL); Seal Pt (SGRDL)
Myllita auriculata E.A. Smith, 1891: KI (unlocalised) (JFM)
Myllita deshayesi d'Orbigny & Récluz, 1850: Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG, MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (TMAG, MAM)
Myllita tasmanica Tenison Woods, 1875: C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, TMAG, QVMAG); Lt Porky Bch (SGRDL); Pass R Bay (TMAG)
Mysella donaciformis Angas, 1878: Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)
Mysella dromanaensis (Gatliff & Gabriel, 1912): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)
Mysella lactea Hedley, 1902: Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)
Scintillona cryptozoica (Hedley, 1917): Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Seal Pt (SGRDL)

Lucinidae
Callucina lacteola (Tate, 1897): KI (unlocalised) (JFM, MAM, WLM)
Cardiolucina crassilirata (Tate, 1887): Currie Hbr (SGRDL); Lavinia Bch (SGRDL)
Codakia perobliqua (Tate, 1892): KI (unlocalised) (QVMAG); W coast of KI (unlocalised) (QVMAG)
Divalucina cumingi (A. Adams & Angas, 1863): Lavinia Bch (SGRDL); Yellow Rock Bch (TMAG, MHR)
Epicodakia tatei (Angas, 1879): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG, MHR); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, MHR); Lavinia Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG, MHR); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL)
Myrtea botanica Hedley, 1918: Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM); Lavinia Bch (SGRDL)
Wallucina assimilis (Angas, 1868): Colliers Bch (SGRDL); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Yellow Rock Bch (TMAG)

Ungulinidae
Diplodonta tasmanica Tenison Woods, 1876: KI (unlocalised) (JFM); Naracoopa (MRG)
Numella adamsi (Angas, 1867): Colliers Bch (SGRDL)

Mactridae
Lutraria rhynchaena Jonas, 1844: Yellow Rock Bch (SGRDL)
Mactra jacksonensis E. A. Smith, 1885: Colliers Bch (SGRDL); Lavinia Bch (SGRDL); Yellow Rock Bch (TMAG)
Mactra pura Reeve, 1854: Lavinia Bch (SGRDL); Yellow Rock Bch (MHR)
Mactrotoma antecedens Iredale, 1930: Cowper Pt, Sea Elephant Bay (SGRDL)
Spisula trigonella (Lamarck, 1818): Lavinia Bch (SGRDL); Naracoopa (SGRDL); Red Hut Pt (SGRDL); Yellow Rock Bch (TMAG, MHR)

Mesodesmatidae
Anapella cycladea (Lamarck, 1818): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Yellow Rock Bch (SGRDL, MHR)
Atactodea cuneata (Lamarck, 1818): S coast of KI (unlocalised) (TMAG)
Paphies elongata (Reeve, 1854): Blowhole, Sea Elephant Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Lavinia Bch (SGRDL, TMAG, MHR, KIM); Naracoopa (SGRDL, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Solenidae
Solen vaginoides (Lamarck, 1818): KI (unlocalised) (QVMAG, KIM, WLM); Lavinia Bch (SGRDL, MHR); Naracoopa (MHR); Yellow Rock Bch (TMAG, MHR)

Donacidae
Donax deltoides Lamarck, 1818: Lavinia Bch (SGRDL); Naracoopa (MHR); Seal Pt (SGRDL)

Psammobiidae
Gari kenyoniana (Pritchard & Gatliff, 1904): Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)
Gari livida (Lamarck, 1818): Colliers Bch (SGRDL)

Tellinidae
Macomona deltoidalis (Lamarck, 1818): Cowper Pt, Sea Elephant Bay (SGRDL); Lavinia Bch (SGRDL); S coast of KI

(unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Veneridae

Callista diemenensis (Hanley, 1844): Blowhole, Sea Elephant Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Grassy Hbr (SGRDL); KI (unlocalised) (WLM); Lavinia Bch (SGRDL, TMAG, MHR, KIM); Naracoopa (SGRDL, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Callista kingii (Gray, 1826): Blowhole, Sea Elephant Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL); Yellow Rock Bch (TMAG, MHR)

Bassina disjecta (Perry, 1811): Bass Strait NE of KI, scallop survey site 42 (TMAG); Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL, KIM); Naracoopa (SGRDL); Yellow Rock Bch (TMAG, MHR)

Chioneryx cardioides (Lamarck, 1818): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)

Dosinia caerulea Reeve, 1850: Blowhole, Sea Elephant Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Lavinia Bch (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Dosinia crocea Deshayes, 1853: Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Lavinia Bch (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR, KIM)

Dosinia victoriae Gatliff & Gabriel, 1914: Elephant Shoal Reef (CJG); Lavinia Bch (MHR); Yellow Rock Bch (MHR)

Gomphinella undulosa (Lamarck, 1818): Black Pt, Seal Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (TMAG, KIM, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, MHR); Red Hut Pt (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL)

Gouldiopa australis Angas, 1865: Colliers Bch (SGRDL)

Irus carditoides (Lamarck, 1818): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR, KIM); Pass R Bay (TMAG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL)

Irus griseus (Lamarck, 1818): Currie Hbr (SGRDL)

Katelysia rhytiphora (Lamy, 1935): Black Pt, Seal Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Lavinia Bch (SGRDL)

Katelysia scalarina (Lamarck, 1818): Cowper Pt, Sea Elephant Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Grassy Hbr (SGRDL); Lavinia Bch (SGRDL, MHR); Naracoopa (MHR); Sea Elephant Bch (unlocalised) (TMAG); Yellow Rock Bch (SGRDL)

Placamen placidum (Philippi, 1844): Lavinia Bch (SGRDL); Naracoopa (SGRDL); Yellow Rock Bch (SGRDL, MHR)

Sunetta vaginalis (Menke, 1843): Lavinia Bch (SGRDL, TMAG)

Tawera gallinula (Lamarck, 1818): Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Grassy Hbr (SGRDL); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG, MHR); S coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Tawera lagopus (Lamarck, 1818): KI (unlocalised) (WLM); Naracoopa (MHR)

GASTROPOPODA

Eoacmaeidae

Eoacmaea calamus (Crosse & Fischer, 1864): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Lt Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL)

Lottiidae

Asteracmea stowae (Verco, 1906): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL); Naracoopa (MRG); Seal Pt (SGRDL)

Lottia mixta (Reeve, 1855): Colliers Bch (SGRDL); Cooper Bluff (MRG); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, MRG); KI (unlocalised) (WLM); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Porky Bch (SGRDL)

Notoacmea alta (Oliver, 1926) KI (unlocalised) (JFM)

Notoacmea corrodenda (May, 1920): C Wickham (E) (SGRDL); Currie Hbr (SGRDL); KI (unlocalised) (JFM); Naracoopa (SGRDL); Pass R Bay (TMAG)

Notoacmea flammea (Quoy & Gaimard, 1834): British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MRG); Pass R Bay (MHR, TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG)

Notoacmea mayi (May, 1923): Fitzmaurice Bay (SGRDL); Lavinia Bch (SGRDL)

Notoacmea petterdi (Tenison Woods, 1876): Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG); Naracoopa (SGRDL)

Patelloida alticostata (Angas, 1865): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL, TMAG, MRG); Fitzmaurice Bay (SGRDL); Fitzmaurice Bay (TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (MHR)

Patelloida insignis (Menke, 1843): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM); Lavinia Bch (SGRDL, TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Patelloida latistrigata (Angas, 1865): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG, MHR); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MRG); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL)

Patelloida victoriana (Singleton, 1937): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Nacellidae

Cellana solida (Blainville, 1825): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cooper Bluff (MRG); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Grassy Hbr (MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (TMAG, QVMAG, WLM); Lavinia Bch (MHR); Lavinia Bch (TMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (TMAG, MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Cellana tramoserica (Holten, 1802): Currie Hbr (MRG); KI (unlocalised) (JFM); Naracoopa (MRG)

Patellidae

Scutellastra chapmani (Tenison Woods, 1876): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); Lavinia Bch (SGRDL, TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MHR); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Scutellastra peronii (Blainville, 1825): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MHR, MRG); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Phasianellidae

Phasianella australis (Gmelin, 1791): KI (unlocalised) (QVMAG, WLM); Lavinia Bch (SGRDL); Yellow Rock Bch (SGRDL)

Phasianella ventricosa Swainson, 1822: Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, TMAG, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Tricolia rosea (Angas, 1867): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL)

Haliotidae

Haliotis laevigata Donovan, 1808: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (QVMAG); Ettrick Bch (SGRDL, TMAG); KI (unlocalised) (KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Porky Bch (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL, MHR)

Haliotis rubra Leach, 1814: Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL, TMAG); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG, MHR); Grassy (unlocalised) (TMAG, MHR); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (offshore, unlocalised) (KIM); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Haliotis scalaris emmae Reeve, 1846: Black Pt, Seal Bay (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (WLM); Naracoopa (SGRDL, TMAG, MHR); Sandblow Bay, Grassy Hbr (SGRDL); S coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR, KIM)

Fissurellidae

Amblychilepas javanicensis (Lamarck, 1822): Grassy (unlocalised) (TMAG); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, MHR); Sandblow Bay, Grassy Hbr (SGRDL); Yellow Rock Bch (TMAG, MHR)

Amblychilepas nigrita (Sowerby, 1834): Fitzmaurice Bay (TMAG – as *A. crucis* (Beddome, 1882)); Grassy (unlocalised) (TMAG); KI (unlocalised) (JFM); Lt Porky Bch (SGRDL); Naracoopa (MHR, MRG)

Amblychilepas oblonga (Menke, 1843): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MRG); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL)

Cosmetalepas concatenatus (Crosse & Fischer, 1864): Colliers Bch (SGRDL); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Victoria Cove (MRG)

Emarginula candida (A. Adams, 1851): British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (TMAG); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG)

Emarginula dilecta (A. Adams, 1851): Black Pt, Seal Bay (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); W coast of KI (unlocalised) (TMAG)

Hemitoma subemarginatum (Blainville, 1819): Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); KI (unlocalised) (WLM); Lavinia Bch (SGRDL); Naracoopa (MHR); Yellow Rock Bch (MHR, TMAG)

Macroschisma productum A. Adams, 1850: KI (unlocalised) (APL)

Macroschisma tasmaniae Sowerby, 1866: Colliers Bch (SGRDL); Grassy (unlocalised) (TMAG); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR); Yellow Rock Bch (TMAG, MHR)

Montfortula rugosa (Quoy & Gaimard, 1834): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E)

(SGRDL); City of Melbourne Bay (TMAG); Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (MRG)

Puncturella harrissoni Beddome, 1882: Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)

Scutus antipodes Montfort, 1810: Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Ettrick Bch (TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); KI (unlocalised) (QVMAG, WLM); Naracoopa (SGRDL, MHR, MRG); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Victoria Cove (MRG)

Tugali cicatricosa A. Adams, 1851: Bass Strait NE of KI, scallop survey site 08 (TMAG); Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Lavinia Bch (SGRDL); Naracoopa (SGRDL); Yellow Rock Bch (TMAG, MHR)

Anatomidae

Anatoma australis Hedley, 1903 / *A.tobeyoides* Geiger & Jansen, 2004: Elephant Shoal Reef (CJG)

Scissurellidae

Incisura remota (Iredale, 1924): Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM)

Sinezona beddomei (Petterd, 1884): Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM)

Sukashitrochus atkinsoni (Tenison Woods, 1877): Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); KI (unlocalised) (WLM); Seal Pt (SGRDL)

Sukashitrochus pulcher (Petterd, 1884): Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (TMAG); Seal Pt (SGRDL)

Chilodontidae

Granata imbricata (Lamarck, 1816): C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Victoria Cove (MRG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Herpetopoma aspersum (Philippi, 1846): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL); E coast of KI (unlocalised) (TMAG); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (MHR)

Herpetopoma fenestratum (Tate, 1893): Fitzmaurice Bay (SGRDL, det. LS)

Herpetopoma scabriusculum (Angas, 1867): Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, QVMAG, WLM); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (MRG)

Liotiidae

Austroliotia australis (Kiener, 1839): C Wickham (E) (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (TMAG); Naracoopa (SGRDL)

Austroliotia botanica (Hedley, 1915): Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Seal Pt (SGRDL)

Munditia subquadrata (Tenison Woods, 1878): Currie Hbr (SGRDL, MRG); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Porky Bch (SGRDL); W coast of KI (unlocalised) (TMAG)

Munditia tasmanica (Tenison Woods, 1875): Elephant Shoal Reef (CJG)

Calliostomatidae

Astele armillata (Wood, 1828): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Elephant Shoal Reef (CJG); KI (unlocalised) (QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (TMAG, MHR)

Astele rubiginosa (Valenciennes, 1846): KI (unlocalised) (MAM)

Astele subcarinata (Swainson, 1855): Elephant Shoal Reef (CJG); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL); Naracoopa (KIM)

Calliostoma allporti (Tenison Woods, 1876): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Seal Pt (SGRDL)

Calliostoma hedleyi Pritchard & Gatliff, 1902: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Grassy Hbr (SGRDL); KI (unlocalised) (JFM); Naracoopa (SGRDL)

Calliostoma incertum (Reeve, 1863): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG)

Calliostoma zietzi Verco, 1905: Elephant Shoal Reef (CJG)

Trochidae

Alcyna kingensis (Gabriel, 1956): Elephant Shoal Reef (CJG)

Austrocochlea constricta (Lamarck, 1822): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL, TMAG); Currie Hbr (SGRDL, MRG); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Foreshore S of Currie (TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (TMAG, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR, KIM, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (TMAG, MRG); Yellow Rock Bch (TMAG, MHR)

Austrocochlea porcata (A. Adams, 1853): Naracoopa (JD)

Bankivia fasciata (Menke, 1830): Colliers Bch (SGRDL); Naracoopa (SGRDL, MHR)

Botelloides bassianus (Hedley, 1911): Elephant Shoal Reef (CJG)

Cantharidella tiberiana (Crosse, 1863): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Naracoopa (SGRDL, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); W coast of KI (unlocalised) (TMAG)

Charisma josephi (Tenison Woods, 1877): Elephant Shoal Reef (CJG)

Chlorodiloma adelaidae (Philippi, 1849): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (TMAG); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); KI (unlocalised) (TMAG, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, KIM, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL, MRG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Chlorodiloma odonte (Wood, 1828): Black Pt, Seal Bay (SGRDL);

C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, MHR)

Clanculus aloysii Tenison Woods, 1876: Elephant Shoal Reef (CJG); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL); Yellow Rock Bch (TMAG, MHR)

Clanculus flagellatus (Philippi, 1848): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR); Surprise Bay (MRG); Victoria Cove (MRG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Clanculus limbatus (Quoy & Gaimard, 1834): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR, MRG); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Clanculus plebejus (Philippi, 1851): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (TMAG); Currie Hbr (SGRDL, MRG); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, QVMAG, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Clanculus undatus (Lamarck, 1816): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL, MRG); Grassy Hbr (MRG); KI (unlocalised) (QVMAG); Naracoopa (TMAG, MHR, KIM); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL, MHR)

Diloma concameratum (Wood, 1828): British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL, TMAG); Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); KI (unlocalised) (JFM, TMAG, QVMAG, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR, MRG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (TMAG, MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (MHR)

Ethminolia vitiliginea Iredale, 1924: Surprise Bay (MRG)

Fossarina legrandi Petterd, 1879: Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, MRG); Ettrick Bch (MRG); Fitzmaurice Bay (SGRDL, TMAG); Fitzmaurice Bay (TMAG); KI (unlocalised) (JFM, WLM); Halfmoon Bay (TMAG, MHR); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)

Fossarina petterdi Crosse, 1870: Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)

Nanula tasmanica (Petterd, 1879): Elephant Shoal Reef (CJG)

Phasianotrochus apicinus (Menke, 1843): Naracoopa (MRG)

Phasianotrochus bellulus (Dunker, 1845): KI (unlocalised) (QVMAG)

Phasianotrochus eximius (Perry, 1811): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (TMAG); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL); Victoria Cove (MRG)

Phasianotrochus irisodontes (Quoy & Gaimard, 1834): City of Melbourne Bay (SGRDL); KI (unlocalised) (JFM, QVMAG); Naracoopa (SGRDL, MHR)

Phasianotrochus rutilis (A. Adams, 1853): Naracoopa (MHR)

Stomatella impertusa (Burrow, 1815): Grassy Hbr (MRG); KI (unlocalised) (WLM); Lavinia Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Yellow Rock Bch (MHR)

Colloniidae

Argalista kingensis May, 1923: Fitzmaurice Bay (TMAG); KI (unlocalised) (TMAG); Surprise Bay (MAM, WLM)

Argalista rosea (Tenison Woods, 1876): Elephant Shoal Reef (CJG); Halfmoon Bay (MHR); Lt Porky Bch (SGRDL)

Turbinidae

Bellastraea aurea (Jonas, 1844): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL, TMAG); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Currie Hbr (MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Bellastraea squamifera (Koch, 1844): Cowper Pt, Sea Elephant Bay (SGRDL); Elephant Shoal Reef (CJG); KI (unlocalised) (KIM, WLM); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Brookula nepeanensis (Gatliff, 1906): Fitzmaurice Bay (SGRDL, TMAG)

Cirsonella reflecta (Laseron, 1954): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL)

Cirsonella weldii (Tenison Woods, 1876): Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, WLM)

Liotella annulata (Tenison Woods, 1878): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG)

Liotella compacta (Petterd, 1884): Fitzmaurice Bay (TMAG)

Liotella johnstoni (Beddome, 1883): Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL)

Lissotesta contabulata Tate, 1899: Ettrick Bch (SGRDL)

Lissotesta micra (Tenison Woods, 1876): Grassy Hbr (MRG)

Lodderena minima (Tenison Woods, 1876): Fitzmaurice Bay (TMAG); KI (unlocalised) (WLM)

Lunella undulata (Lightfoot, 1786): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL, TMAG); Colliers

Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Putilla porcellana (Tate & May, 1900): Elephant Shoal Reef (CJG); Grassy Hbr (MRG)

Turbo gruneri Philippi, 1846: Cowper Pt, Sea Elephant Bay (SGRDL); Grassy Hbr (SGRDL); KI (unlocalised) (TMAG, QVMAG, WLM); Yellow Rock Bch (MHR, KIM)

Zalipais inscripta (Tate, 1899): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM)

Neritidae

Nerita atramentosa Reeve, 1855: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, KIM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MHR); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (MRG)

Plesiotrochidae

Plesiotrochus monachus (Crosse & Fischer, 1864): Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Naracoopa (SGRDL); W coast of KI (unlocalised) (TMAG)

Batillariidae

Velacumantus australis (Quoy & Gaimard, 1834): Naracoopa (MHR)

Zeacumantus diemenensis (Quoy & Gaimard, 1834): British Admiral Bch (TMAG); Cataraqui Pt (MHR); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); KI (unlocalised) (QVMAG, WLM); Lavinia Bch (SGRDL, KIM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MHR); Pass R Bay (TMAG); Sea Elephant Lagoon (MRG); W coast of KI (unlocalised) (TMAG)

Zeacumantus estuarinus (Tate, 1893): Sea Elephant Lagoon (MRG)

Cerithiidae

Cacozeliana granaria Kiener, 1842: C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM); Naracoopa (TMAG); Pass R Bay (TMAG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG)

Dialidae

Diala megapicalis Ponder & de Keyzer, 1992: Ettrick Bch (SGRDL, MRG)

Diala suturalis (A. Adams, 1853): Currie Hbr (SGRDL); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Pass R Bay (TMAG)

Litiopidae

Alaba monile (A. Adams, 1862): Ettrick Bch (SGRDL)

Alaba pulchra A. Adams, 1862: Halfmoon Bay (TMAG, MHR)

Siliquariidae

Pyxipoma weldii (Tenison Woods, 1875): Black Pt, Seal Bay (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Naracoopa (SGRDL); Seal Pt (SGRDL)

Stephopoma cf. *nucleogranosum* Verco, 1904: Fitzmaurice Bay (SGRDL)

Tenagodus australis (Quoy & Gaimard, 1834): Elephant Shoal Reef (CJG)

Turritellidae

Colpospira australis (Lamarck, 1822): Colliers Bch (SGRDL); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL); Naracoopa (SGRDL)

Gazameda gunnii (Reeve, 1848): KI (unlocalised) (QVMAG, KIM); Lavinia Bch (SGRDL, MHR); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Gazameda iredalei Finlay, 1927: KI (unlocalised) (QVMAG, MAM)

Gazameda tasmanica (Reeve, 1849): KI (unlocalised) (QVMAG)

Maoricolpus roseus (Quoy & Gaimard, 1834): Disappointment Bay (SGRDL); Grassy Hbr (SGRDL); Naracoopa (SGRDL)

Calyptraeidae

Maoricrypta immersa (Angas, 1865): Bass Strait NE of KI, scallop survey site 08 (TMAG); Colliers Bch (SGRDL); Lavinia Bch (SGRDL); Naracoopa (SGRDL); Yellow Rock Bch (SGRDL)

Sigapatella calyptraeformis (Lamarck, 1822): Blowhole, Sea Elephant Bay (SGRDL); Colliers Bch (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL, TMAG, MHR); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (SGRDL, TMAG, MHR)

Sigapatella hedleyi (E. A. Smith, 1915): Lavinia Bch (SGRDL)

Cingulopsidae

Eatonina condita Ponder & Yoo, 1980: Fitzmaurice Bay (TMAG); Pass R Bay (TMAG)

Eatoniellidae

Crassitoniella erratica (May, 1913): Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL); Halfmoon Bay (TMAG); Surprise Bay (MRG)

Crassitoniella flammea (Frauenfeld, 1867): Elephant Shoal Reef (CJG)

Eatoniella atrella Ponder & Yoo, 1978: Fitzmaurice Bay (SGRDL, TMAG); Pass R Bay (TMAG)

Eatoniella depressa Ponder & Yoo, 1978: Fitzmaurice Bay (SGRDL)

Eatoniella fulva Ponder & Yoo, 1978: Pass R Bay (TMAG)

Eatoniella galbinia (Laseron, 1950): Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR)

Eatoniella melanochroma (Tate, 1899): Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL); Surprise Bay (MRG)

Eatoniella puniceolinea Ponder & Yoo, 1978: Fitzmaurice Bay (SGRDL)

Eatoniella shepherdi Ponder & Yoo, 1978: Fitzmaurice Bay (TMAG)

Cypraeidae

Notocypraea angustata (Gmelin, 1791): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Unlucky Bay

(KJB); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)

Notocypraea comptoni (Gray, 1847): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (QVMAG, KIM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); S coast of KI (unlocalised) (TMAG); Unlucky Bay (KJB); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)

Notocypraea declivis (Sowerby, 1870): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, KIM); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL)

Notocypraea piperita (Gray, 1825): Black Pt, Seal Bay (SGRDL); Currie Hbr (SGRDL); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, QVMAG); Naracoopa (SGRDL, MHR, KIM, MRG); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL)

Notocypraea subcarnea (Beddome, 1896): Black Pt, Seal Bay (SGRDL); Seal Pt (SGRDL)

Umbilia hesitata (Iredale, 1916): Cowper Pt, Sea Elephant Bay (SGRDL); KI (offshore, unlocalised) (KIM)

Epitoniidae

Cirsotrema translucidum (Gatliff, 1906): Elephant Shoal Reef (CJG)

Epitonium jukesianum (Forbes, 1852): Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)

Epitonium minorum (Iredale, 1936): Black Pt, Seal Bay (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (JFM); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL)

Opalia australis (Lamarck, 1822): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)

Opalia granosa (Quoy & Gaimard, 1834): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, KIM, MHR); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Seal Pt (SGRDL)

Janthinidae

Janthina janthina (Linnaeus, 1758): Fitzmaurice Bay (SGRDL, TMAG)

Eulimidae

Eulima petterdi (Beddome, 1882): Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); KI (unlocalised) (WLM); Seal Pt (SGRDL)

Eulima tenisoni (Tryon, 1886): Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Seal Pt (SGRDL)

Fusceulima perexigua (Tate & May, 1900): Fitzmaurice Bay (SGRDL)

Leiostraca kilcundae (Gatliff & Gabriel, 1914): Fitzmaurice Bay (SGRDL; TMAG)

Melanella augur (Angas, 1865): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, QVMAG, WLM); Naracoopa (SGRDL, MRG); Pass R Bay (TMAG)

Scalenostoma lodderae Petterd, 1884: Naracoopa (SGRDL); Sandblow Bay (SGRDL)

Vitreolina commensalis (Tate, 1898): Elephant Shoal Reef (CJG)

Littorinidae

Afrolittorina praetermissa (May, 1909): British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (TMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (SGRDL); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG)

Austrolittorina unifasciata (Gray, 1826): C Wickham (E) (SGRDL); Cataraqui Pt (MHR); Cooper Bluff (MRG); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Gulchway, Stokes Pt (SGRDL); KI (unlocalised) (JFM, TMAG, QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (SGRDL)

Bembicium melanostoma (Gmelin, 1791): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Lavinia Bch (SGRDL); Pass R Bay (TMAG); Porky Bch (SGRDL); Sea Elephant Lagoon (MRG); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG)

Bembicium nanum (Lamarck, 1822): Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); Cooper Bluff (MRG); Disappointment Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Grassy (unlocalised) (MHR); Grassy Hbr (SGRDL, MRG); KI (unlocalised) (TMAG); Naracoopa (SGRDL, TMAG, MHR, KIM); Porky Bch (SGRDL); Surprise Bay (MRG); Victoria Cove (TMAG, MRG); Yellow Rock Bch (MHR)

Laevilitorina mariae (Tenison Woods, 1876): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (TMAG); Lt Porky Bch (SGRDL); Naracoopa (TMAG, MHR); Pass R Bay (TMAG)

Macquariella kingensis (May, 1924): Colliers Bch (SGRDL); Currie Hbr (SGRDL, TMAG, MRG, WLM); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)

Risellopsis mutabilis May, 1909: KI (unlocalised) (WLM)

Rufolacuna bruniensis (Beddome, 1883): Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL)

Naticidae

Conuber conicus (Lamarck, 1822): KI (unlocalised) (QVMAG, KIM); Naracoopa (SGRDL, TMAG, MHR); Yellow Rock Bch (TMAG, MHR)

Conuber controversus (Pritchard & Gatliff, 1913): Naracoopa (SGRDL)

Eunaticina umbilicata (Quoy & Gaimard, 1833): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MHR); Pass R Bay (TMAG); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (MHR)

Naticarius subcostatus (Tenison Woods, 1878): Elephant Shoal Reef (CJG)

Neverita aulacoglossa (Pilsbry & Vanatta, 1908): Cowper Pt, Sea Elephant Bay (SGRDL); Fitzmaurice Bay (TMAG);

KI (unlocalised) (QVMAG, KIM); Lavinia Bch (SGRDL); Naracoopa (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)
Sinum zonale (Quoy & Gaimard, 1833): Naracoopa (MHR)
Tanea sagittata (Menke, 1843): KI (unlocalised) (QVMAG)

Pterotracheidae
Pterotrachea kingicola van Gooch, 1942: KI (unlocalised) (QVMAG)

Anabathridae
Amphithalamus incidatus (Frauenfeld, 1867): KI (unlocalised) (WLM)
Amphithalamus 'obesus' H. Adams, 1866 (not true *A. obesus* according to LS): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (TMAG)
Amphithalamus triangulus (May, 1915): Elephant Shoal Reef (CJG)
Anabathron contabulatum (Frauenfeld, 1867): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)
Anabathron lene Hedley, 1918: Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL)
Anabathron luteofuscus May, 1920: Fitzmaurice Bay (SGRDL, TMAG)
Badepigrus pupoides (H. Adams, 1865): Colliers Bch (SGRDL); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR)
Microdryas iravadioides (Gatliff & Gabriel, 1913): Fitzmaurice Bay (TMAG)
Pisinna approxima (Petterd, 1884): Colliers Bch (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (MRG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, WLM); Pass R Bay (TMAG)
Pisinna bicolor (Petterd, 1884): Elephant Shoal Reef (CJG)
Pisinna circumlabra Ponder & Yoo, 1976: Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR)
Pisinna costata (Hedley, 1911): Elephant Shoal Reef (CJG)
Pisinna dubitabilis (Tate, 1899): Colliers Bch (SGRDL); Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG)
Pisinna frenchiensis (Gatliff & Gabriel, 1908): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Halfmoon Bay (TMAG, MHR)
Pisinna kershawi (Tenison Woods, 1878): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR)
Pisinna megastoma Ponder & Yoo, 1976: Fitzmaurice Bay (TMAG); Pass R Bay (TMAG)
Pisinna nitida Ponder & Yoo, 1976: Fitzmaurice Bay (TMAG)
Pisinna olivacea (Frauenfeld, 1867): Fitzmaurice Bay (SGRDL)
Pisinna sp. nov.: Lt Porky Bch (SGRDL, det. LS)
Pisinna tumida (Tenison Woods, 1876): Elephant Shoal Reef (CJG); Lt Porky Bch (SGRDL)
Pisinna varicifera relata (Cotton, 1944): Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR)

Assimineidae
Cryptassiminea buccinoides (Quoy & Gaimard, 1834): Sea Elephant Lagoon (MRG)

Caecidae
Caecum amputatum Hedley, 1894: Fitzmaurice Bay (SGRDL)

Elachisinidae
Dolicrossea labiata (Tenison Woods, 1876): Elephant Shoal Reef (CJG)

Hydrobiidae
Ascorbis tasmanica (Martens, 1858): Fitzmaurice Bay (TMAG)

Pomatiopsidae
Coxiella striata (Reeve, 1842): Cape Wickham (unlocalised) (SGRDL); L. Flannigan (QVMAG)

Rissoidae
Alvania fasciata (Tenison Woods, 1876): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, WLM); Halfmoon Bay (TMAG, MHR); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)
Alvania strangei (Brazier, 1894): Cataraqui Pt (MHR); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Halfmoon Bay (TMAG, MHR); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)
Lironoba australis (Tenison Woods, 1877): Cataraqui Pt (MHR); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (TMAG, MHR, MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)
Lironoba layardi (Petterd, 1884): Fitzmaurice Bay (TMAG)
Lironoba unilirata (Tenison Woods, 1878): Colliers Bch (SGRDL); KI (unlocalised) (WLM); Seal Pt (SGRDL)
Merelina cancellata Crioscino & Ponder, 2011: Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL); KI (unlocalised) (JFM, WLM); Seal Pt (SGRDL)
Merelina hirta Crioscino & Ponder, 2011: Halfmoon Bay (MHR)
Merelina sp. nov.: Fitzmaurice Bay (SGRDL, preliminary det. LS)
Onoba multilirata (May, 1915): Colliers Bch (SGRDL)
Onoba supracostata (May, 1919): Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL)
Powellisetia simillima (May, 1915): Fitzmaurice Bay (SGRDL)
Pusillina discrepans (Tate & May, 1900): Elephant Shoal Reef (CJG)
Rissoina angasi Pease, 1872: Currie Hbr (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (WLM); Seal Pt (SGRDL)
Rissoina elegantula Angas, 1880: Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (MRG)
Rissoina fasciata (A. Adams, 1853): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG)
Rissoina gertrudis Tenison Woods, 1876: Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG); KI (unlocalised) (TMAG); Lt Porky Bch (SGRDL)
Rissoina rhyllensis Gatliff & Gabriel, 1908: Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)
Rissoina vincentiana Cotton, 1952: Currie Hbr (MRG); Ettrick Bch (MRG); Grassy Hbr (MRG)

Tornidae
Circulus harriettae (Petterd, 1884): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)

Truncatellidae
Truncatella scalarina (Cox, 1867): KI (unlocalised) (TMAG)

Ranellidae
Argobuccinum pustulosum (Lightfoot, 1786): Boulder Pt (KIM); C Wickham (E) (SGRDL); Disappointment Bay (SGRDL); Lavinia Bch (MHR); Seal Pt (SGRDL)
Cabestana spengleri (Perry, 1811): Black Pt, Seal Bay (SGRDL); City of Melbourne Bay (SGRDL); KI (unlocalised) (KIM, WLM);

Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR, MRG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Cabestana tabulata (Menke, 1843): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (QVMAG, KIM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL); Yellow Rock Bch (TMAG, MHR)

Charonia rubicunda (Perry, 1811): KI (offshore, unlocalised) (KIM)

Monoplex parthenopeum (von Salis, 1793): KI (offshore, unlocalised) (KIM); KI (unlocalised) (APL); Naracoopa (SGRDL)

Ranella australasia (Perry, 1811): KI (offshore, unlocalised) (KIM)

Sassia bassi (Angas, 1869): Black Pt, Seal Bay (SGRDL); City of Melbourne Bay (SGRDL); KI (unlocalised) (KIM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, MHR); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Sassia eburnea (Reeve, 1844): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG, KIM); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL, MRG); W coast of KI (unlocalised) (TMAG)

Sassia epitrema (Tenison Woods, 1877): Naracoopa (SGRDL, KIM)

Sassia subdistorta (Lamarck, 1822): Bass Strait NE of KI, scallop survey site 05 (TMAG); Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Grassy Hbr (SGRDL); KI (unlocalised) (QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Sassia verrucosa (Reeve, 1844): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, KIM, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL); Victoria Cove (MRG)

Tonnidae

Semicassis pyrum (Lamarck, 1822): Black Pt, Seal Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (offshore, unlocalised) (KIM); Lavinia Bch (SGRDL, MHR); Lt Porky Bch (SGRDL); Naracoopa (MHR); Yellow Rock Bch (SGRDL, MHR)

Semicassis semigranosa (Lamarck, 1822): Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (JFM, QVMAG, KIM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG); Yellow Rock Bch (SGRDL, MHR)

Cerithiopsidae

Prolixodens cessicus (Hedley, 1906): Fitzmaurice Bay (TMAG)

Prolixodens dannevigi (Hedley, 1911): Elephant Shoal Reef (CJG)

Seila albosutura (Tenison Woods, 1877): C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, QVMAG, WLM); Lt Porky Bch (SGRDL)

Specula regina Cotton, 1951: Fitzmaurice Bay (SGRDL, det. LS)

Specula turbonilloides (Tenison Woods, 1879): Halfmoon Bay (TMAG, MHR); KI (unlocalised) (WLM); Pass R Bay (TMAG)

Newtoniellidae

Ataxocerithium serotinum (A. Adams, 1855): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Elephant Shoal Reef (CJG); KI (unlocalised) (JFM, QVMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)

Socienna angasi (Semper, 1874): Elephant Shoal Reef (CJG)

Socienna trisculpta (May, 1913): Fitzmaurice Bay (SGRDL; TMAG); Halfmoon Bay (TMAG, MHR)

Zaclys semilaevis (Tenison Woods, 1877): Fitzmaurice Bay (TMAG)

Triphoridae

Aclophoropsis festiva (A. Adams, 1851): C Wickham (E) (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Pass R Bay (TMAG)

Brucetriphora granifera (Brazier, 1894): C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Ettrick Bch (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (TMAG); Pass R Bay (TMAG)

Eutriphora armillata (Verco, 1909): Fitzmaurice Bay (TMAG, MHR)

Eutriphora cana (Verco, 1909): Pass R Bay (TMAG)

Hedleytriphora basimacula Marshall, 1983: Elephant Shoal Reef (CJG)

Hedleytriphora fasciata (Tenison Woods, 1879): Colliers Bch (SGRDL); Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM)

Hedleytriphora scitula (A. Adams, 1851): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Pass R Bay (TMAG)

Isotriphora amethystina Marshall, 1983: Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (TMAG)

Isotriphora tasmanica (Tenison Woods, 1875): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG)

Monophorus angasi (Crosse & Fischer, 1865): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Halfmoon Bay (MHR); KI (unlocalised) (WLM)

Monophorus nigrofuscus (A. Adams, 1851): Elephant Shoal Reef (CJG)

Obesula mamillata (Verco, 1909): Fitzmaurice Bay (TMAG)

Vanikoridae

Naricava vincentiana (Angas, 1880): Naracoopa (MRG); Seal Pt (SGRDL)

Capulidae

Capulus danieli (Crosse, 1858): KI (unlocalised) (JFM)

Hipponicidae

Antisabia foliacea (Quoy & Gaimard, 1835): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (MHR); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG)

Hipponix australis (Lamarck, 1819): Bass Strait NE of KI, scallop survey site 04 (TMAG); Bass Strait NE of KI, scallop survey site 08 (TMAG); Bass Strait NE of KI, scallop survey site 11 (TMAG); Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cowper Pt, Sea

Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy (unlocalised) (TMAG, MHR); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)

Eratoidae

Proterato lachryma (Sowerby, 1832): Fitzmaurice Bay (TMAG, KIM); Grassy Hbr (SGRDL); Seal Pt (SGRDL)

Triviidae

Ellatrivia merces (Iredale, 1924): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (MHR); KI (unlocalised) (KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Porky Bch (SGRDL); Seal Pt (SGRDL); W coast of KI (unlocalised) (TMAG)

Velutinidae

Lamellaria ophione Gray, 1849: Ettrick Bch (SGRDL)

Vermetidae

Dendropoma nucleocostatum (May, 1916): Black Pt, Seal Bay (SGRDL); Currie Hbr (SGRDL)

Petaloconchus caperatus (Tate & May, 1900): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Colliers Bch (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL)

Serpulorbis sipho (Lamarck, 1818): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Buccinidae

Cominella eburnea (Reeve, 1846): Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); KI (unlocalised) (JFM, QVMAG, WLM); Naracoopa (SGRDL, MHR, KIM)

Cominella lineolata (Lamarck, 1809): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL, TMAG); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG)

Penion mandarinus (Duclos, 1831): Black Pt, Seal Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (offshore, unlocalised) (KIM); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Porky Bch (SGRDL); Surprise Bay (SGRDL)

Penion maximus (Tryon, 1881): Cowper Pt, Sea Elephant Bay (SGRDL); KI (offshore, unlocalised) (KIM); Lavinia Bch (SGRDL); Naracoopa (MHR)

Tasmeuthria clarkei (Tenison Woods, 1876): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); W coast of KI (unlocalised) (TMAG)

Tasmeuthria kingicola (Tate & May, 1900): Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM, WLM)

Colubrariidae

Cumia bednalli (Brazier, 1875): Elephant Shoal Reef (CJG); Halfmoon Bay (MHR); KI (unlocalised) (JFM)

Cumia mestayerae (Iredale, 1915): Black Pt, Seal Bay (SGRDL); Currie Hbr (MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, KIM); Surprise Bay (SGRDL)

Columbellidae

Aesopus gatliffi (Verco, 1909): Elephant Shoal Reef (CJG)

Aesopus plurisulcatus (Reeve, 1859): KI (unlocalised) (MAM, WLM)

Anachis atkinsoni (Tenison Woods, 1876): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Grassy Hbr (MRG); Lt Porky Bch (SGRDL); Naracoopa (MRG)

Anachis beachportensis (Verco, 1910): Seal Pt (SGRDL)

Gatliffena fenestrata (Tate & May, 1900): Fitzmaurice Bay (TMAG)

Mitrella austrina (Gaskoin, 1851): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Fitzmaurice Bay (TMAG); Foreshore S of Currie (TMAG); Grassy Hbr (SGRDL); Naracoopa (SGRDL, MRG); Seal Pt (SGRDL); Surprise Bay (MRG)

Mitrella leucostoma (Gaskoin, 1852): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (MRG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (MRG)

Mitrella lincolnensis (Reeve, 1859): Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (TMAG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (TMAG, QVMAG); Naracoopa (MRG); Pass R Bay (TMAG); W coast of KI (unlocalised) (TMAG)

Mitrella menkeana (Reeve, 1858): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Currie Hbr (MRG); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG, MHR); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (MRG)

Mitrella semiconvexa (Lamarck, 1822): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG)

Mitrella tenuis (Gaskoin, 1852): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Foreshore S of Currie (TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, QVMAG, WLM); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Victoria Cove (MRG)

Pseudamycla dermestoidea (Lamarck, 1822): Naracoopa (MRG)
Pseudamycla miltostoma (Tenison Woods, 1876): Fitzmaurice Bay (SGRDL)
Pyreneola fulgida (Reeve, 1859): Colliers Bch (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)
Pyreneola lurida (Hedley, 1907): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL); Seal Pt (SGRDL)
Retizafra calva (Verco, 1910): Elephant Shoal Reef (CJG)
Zafra legrandi (Tenison Woods, 1876): Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); KI (unlocalised) (TMAG, QVMAG, WLM); W coast of KI (unlocalised) (TMAG)

Fasciolariidae
Australaria australasia (Perry, 1811): Bass Strait NE of KI, scallop survey site 08 (TMAG); Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cooper Bluff (MRG); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG, MRG); Fitzmaurice Bay (SGRDL, TMAG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MHR, MRG); Pass R Bay (TMAG); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL, MRG); Yellow Rock Bch (SGRDL, MHR)
Dolicholatirus spiceri (Tenison Woods, 1876): C Wickham (E) (SGRDL); Currie Hbr (SGRDL); KI (unlocalised) (TMAG, WLM)
Fusinus novaehollandiae (Reeve, 1847): Cowper Pt, Sea Elephant Bay (SGRDL); KI (offshore, unlocalised) (KIM); Naracoopa (SGRDL)
Fusinus undulatus (Perry, 1811): Black Pt, Seal Bay (SGRDL); Currie Hbr (SGRDL); KI (unlocalised) (QVMAG, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, KIM); Red Hut Pt (SGRDL)

Nassariidae
Nassarius compactus (Angas, 1865): Currie Hbr (SGRDL); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Pass R Bay (TMAG); Seal Pt (SGRDL)
Nassarius nigellus (Reeve, 1854): Naracoopa (SGRDL)
Nassarius pauperatus (Lamarck, 1822): Naracoopa (SGRDL, MHR)
Nassarius pyrrhus (Menke, 1843): KI (unlocalised) (QVMAG); Naracoopa (SGRDL, KIM)

Cancellariidae
Cancellaria granosa Sowerby, 1832: Disappointment Bay (SGRDL); KI (unlocalised) (QVMAG); Naracoopa (SGRDL, TMAG, KIM); S coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)
Cancellaria lactea Deshayes, 1830: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (QVMAG); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, KIM); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)
Cancellaria purpuriformis Kiener, 1841: KI (unlocalised) (TMAG, QVMAG); Naracoopa (SGRDL)
Cancellaria spirata Lamarck, 1822: KI (unlocalised) (WLM); Naracoopa (SGRDL, TMAG, MHR, KIM)
Cancellaria undulata Sowerby, 1849: KI (unlocalised) (JFM, QVMAG); Naracoopa (SGRDL, TMAG, KIM); Yellow Rock Bch (TMAG, MHR)

Clathurellidae
Etrema bicolor (Angas, 1871): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); KI (unlocalised) (JFM)
Etrema denseplicata (Dunker, 1871): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); KI (unlocalised) (JFM); Seal Pt (SGRDL)

Conidae
Conus anemone Lamarck, 1810: Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL, TMAG); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, TMAG, MHR)
Conus clarus E. A. Smith, 1881: Elephant Shoal Reef (CJG); Naracoopa (SGRDL)
Conus rutilus Menke, 1843: Elephant Shoal Reef (CJG); KI (unlocalised) (JFM)

Drilliidae
Paracuneus immaculatus (Tenison Woods, 1876): KI (unlocalised) (TMAG, QVMAG)

Horaiclavidae
Austrodrillia beraudiana (Crosse, 1863): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Porky Bch (SGRDL); W coast of KI (unlocalised) (TMAG)
Austrodrillia saxea (Sowerby, 1896): Elephant Shoal Reef (CJG)

Mangeliidae
Guraleus alucinans (Sowerby, 1896): Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)
Guraleus australis (A. Adams & Angas, 1863): Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Naracoopa (SGRDL); KI (unlocalised) (JFM)
Guraleus delicatulus (Tenison Woods, 1878): C Wickham (E) (SGRDL); Elephant Shoal Reef (CJG)
Guraleus mitralis (A. Adams & Angas, 1863): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Halfmoon Bay (MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL)
Guraleus pictus (A. Adams & Angas, 1863): Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, WLM); Naracoopa (SGRDL); Pass R Bay (TMAG); Porky Bch (SGRDL)
Guraleus tasmanicus (Tenison Woods, 1876): W coast of KI (unlocalised) (TMAG)
Marita compta (A. Adams & Angas, 1864): KI (unlocalised) (JFM)

Mitromorphidae
Mitromorpha alba (Petterd, 1879): C Wickham (E) (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); KI

(unlocalised) (JFM, WLM); Lt Porky Bch (SGRDL); Naracoopa (MRG)
Mitromorpha bassiana Gabriel, 1956: Elephant Shoal Reef (CJG)
Mitromorpha macphersonae Gabriel, 1956: Elephant Shoal Reef (CJG)

Pseudomelatomidae
Epidirona philipineri Tenison Woods, 1877: KI (unlocalised) (QVMAG); Naracoopa (SGRDL, MHR)

Raphitomidae
Asperdaphne bastowi (Gatlifff & Gabriel, 1908): Elephant Shoal Reef (CJG)
Asperdaphne desalesii (Tenison Woods, 1877): Halfmoon Bay (MHR); W coast of KI (unlocalised) (TMAG)
Asperdaphne legrandi (Beddome, 1883): KI (unlocalised) (JFM)
Asperdaphne perplexa (Verco, 1909): Elephant Shoal Reef (CJG)
Asperdaphne sculptilis (Angas, 1871): Elephant Shoal Reef (CJG)
Asperdaphne tasmanica (Tenison Woods, 1876): Currie Hbr (SGRDL); KI (unlocalised) (JFM, WLM)
Exomilus dyscritos (Verco, 1906): Fitzmaurice Bay (TMAG)
Exomilus telescopialis (Verco, 1896): Elephant Shoal Reef (CJG)
Nepotilla lamellosa (Sowerby, 1896): Elephant Shoal Reef (CJG)
Paramontana mayana (Hedley, 1922): Fitzmaurice Bay (TMAG)
Paramontana rufozonata (Angas, 1877): Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL)
Zenepos minuta (Tenison Woods, 1877): Fitzmaurice Bay (SGRDL); Elephant Shoal Reef (CJG)

Terebridae
Duplicaria ustulata (Deshayes, 1857): Black Pt, Seal Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (WLM); Naracoopa (SGRDL)
Terebra albida Gray, 1834: KI (unlocalised) (JFM, MAM, WLM)
Terebra tristis Deshayes, 1859: Colliers Bch (SGRDL); Naracoopa (SGRDL)

Costellariidae
Austromitra analogica (Reeve, 1845): British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL, MRG); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, QVMAG, TMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MRG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (MRG)

Costellariidae
Vexillum australe (Swainson, 1820): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, KIM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Porky Bch (SGRDL); Red Hut Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG)

Cystiscidae
Cystiscus angasi (Crosse, 1870): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (MRG); KI (unlocalised) (WLM)
Cystiscus halli (Pritchard & Gatliff, 1899): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)
Cystiscus minutissimus (Tenison Woods, 1876): Elephant Shoal Reef (CJG)
Cystiscus obesulus (May, 1919): Currie Hbr (MRG); Naracoopa (MRG)
Cystiscus subauriculatus (May, 1916): Colliers Bch (SGRDL); Elephant Shoal Reef (CJG)
Gibberula agapeta (Watson, 1886): Elephant Shoal Reef (CJG)
Gibberula diplostreptus (May, 1916): Halfmoon Bay (MHR); Naracoopa (SGRDL)
Gibberula subbulbosa (Tate, 1878): Currie Hbr (MRG); Ettrick Bch (SGRDL); Fitzmaurice Bay (TMAG); Halfmoon Bay (MHR); KI (unlocalised) (WLM)
Persicula pulchella (Kiener, 1834): Fitzmaurice Bay (SGRDL)

Marginellidae
Austroginella formicula (Lamarck, 1822): Colliers Bch (SGRDL); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Sandblow Bay, Grassy Hbr (SGRDL)
Austroginella muscaria (Lamarck, 1822): KI (unlocalised) (QVMAG)
Austroginella tasmanica (Tenison Woods, 1876): Naracoopa (SGRDL, MHR)
Dentimargo dentiens (May, 1911): Halfmoon Bay (TMAG)
Dentimargo gabrieli (May, 1911): Elephant Shoal Reef (CJG)
Hydroginella columnaria (Hedley & May, 1908): KI (unlocalised) (QVMAG)
Hydroginella tridentata (Tate, 1878): Fitzmaurice Bay (TMAG)
Mesoginella altilabra (May, 1911): Fitzmaurice Bay (TMAG)
Mesoginella pygmaeoides (Singleton, 1937): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); Currie Hbr (SGRDL, MRG, KIM); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (TMAG, QVMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL)
Mesoginella translucida (Sowerby, 1846): KI (unlocalised) (JFM)
Mesoginella turbinata (Sowerby, 1846): Elephant Shoal Reef (CJG); KI (unlocalised) (JFM); Naracoopa (SGRDL)
Ovaginella ovulum (Sowerby, 1846): KI (unlocalised) (JFM)
Ovaginella pisum (Reeve, 1865): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG)
Serrata mustelina (Angas, 1871): Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL, KIM); Grassy Hbr (SGRDL); KI (unlocalised) (JFM); Naracoopa (MRG)
Serrata vincentiana (Cotton, 1944): KI (unlocalised) (WLM)

Mitridae
Mitra badia Reeve, 1844: Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, QVMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL)
Mitra glabra Swainson, 1821: Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); KI (unlocalised) (QVMAG, KIM, WLM); Naracoopa (SGRDL, TMAG, MHR); Seal Pt (SGRDL)

Muricidae
Agnewia tritoniformis (Blainville, 1832): C Wickham (E) (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); Naracoopa (SGRDL, MHR, KIM)
Bedeva paivae (Crosse, 1864): KI (unlocalised) (QVMAG); Naracoopa (SGRDL, TMAG, MHR, KIM)
Dermomurex goldsteini (Tenison Woods, 1876): Black Pt, Seal Bay (SGRDL); KI (unlocalised) (WLM)
Dicathais orbita (Gmelin, 1791): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Cataraqui Pt (MHR); City of Melbourne Bay (SGRDL, TMAG); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL);

Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, KIM, WLM); Lavinia Bch (SGRDL); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (TMAG, MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)

Haustrum baileyanum (Tenison Woods, 1881): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Grassy Hbr (SGRDL); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL)

Haustrum vinosum (Lamarck, 1822): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL); Cooper Bluff (MRG); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, TMAG, QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Victoria Cove (TMAG, MRG); W coast of KI (unlocalised) (TMAG)

Litozamia brazieri (Tenison Woods, 1875): Black Pt, Seal Bay (SGRDL); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (MHR); Halfmoon Bay (TMAG); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL)

Litozamia petterdi (Crosse, 1870): Elephant Shoal Reef (CJG); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM)

Litozamia rudolphi (Brazier, 1894): Fitzmaurice Bay (SGRDL)

Muricopsis umbilicatus (Tenison Woods, 1876): KI (unlocalised) (JFM); Naracoopa (SGRDL)

Phycothais reticulata (Blainville, 1832): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Pass R Bay (TMAG); Porky Bch (SGRDL); Seal Pt (SGRDL); S coast of KI (unlocalised) (TMAG); Surprise Bay (SGRDL, MRG); W coast of KI (unlocalised) (TMAG)

Phyllocoma eburnea (Petterd, 1884): Halfmoon Bay (MHR); KI (unlocalised) (QVMAG, MV)

Prototyphis angasi (Crosse, 1863): Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); Currie Hbr (SGRDL); Fitzmaurice Bay (TMAG); Grassy Hbr (SGRDL); KI (unlocalised) (JFM, QVMAG, KIM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); W coast of KI (unlocalised) (TMAG)

Pterochelus triformis (Reeve, 1845): Black Pt, Seal Bay (SGRDL); Elephant Shoal Reef (CJG); Ettrick Bch (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, KIM, MRG); Yellow Rock Bch (TMAG, MHR)

Volutidae

Amoria undulata (Lamarck, 1804): Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); City of Melbourne Bay (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (QVMAG, KIM, WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Sandblow Bay, Grassy Hbr (SGRDL); Yellow Rock Bch (SGRDL, TMAG, MHR)

Ericusa papillosa (Swainson, 1822): KI (offshore, unlocalised) (KIM)

Ericusa sowerbyi (Kiener, 1839): Black Pt, Seal Bay (SGRDL); KI (offshore, unlocalised) (KIM); Lavinia Bch (SGRDL)

Livonia mammilla (Sowerby, 1844): Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (QVMAG); Lavinia Bch (KIM)

Livonia roadnightae (McCoy, 1881): KI (offshore, unlocalised) (KIM)

Lyria mitraeformis (Lamarck, 1811): Fitzmaurice Bay (TMAG); Naracoopa (KIM)

Volutomitridae

Waimatea obscura (Hutton, 1873): Black Pt, Seal Bay (SGRDL); Currie Hbr (SGRDL, MRG); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, KIM, MRG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Surprise Bay (SGRDL, MRG); W coast of KI (unlocalised) (TMAG)

Olividae

Amalda marginata (Lamarck, 1811): Black Pt, Seal Bay (SGRDL); Elephant Shoal Reef (CJG); Halfmoon Bay (MHR); KI (unlocalised) (KIM, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR); Seal Pt (SGRDL); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (SGRDL, MHR)

Amalda petterdi (Tate, 1893): KI (unlocalised) (JFM)

Architectonicidae

Philippia lutea (Lamarck, 1822): Black Pt, Seal Bay (SGRDL); Grassy Hbr (SGRDL)

Graphididae

Coenaculum minutulum (Tate & May, 1900): Fitzmaurice Bay (TMAG)

Murchisonellidae

Koloonella micra (Petterd, 1884): Fitzmaurice Bay (SGRDL)

Orbitestellidae

Microdiscula charopa Tate, 1899: Ettrick Bch (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (WLM); Surprise Bay (MRG)

Orbitestella bastowi (Gatliff, 1906): Fitzmaurice Bay (SGRDL); Lt Porky Bch (SGRDL)

Orbitestella cf *decorata* Laseron, 1954: Fitzmaurice Bay (SGRDL)

Pyramidellidae

Cinctiuga diaphana (Verco, 1906): Fitzmaurice Bay (SGRDL, TMAG)

Hinemoa tasmanica (Tenison Woods, 1877): Ettrick Bch (SGRDL); Lt Porky Bch (SGRDL)

Linopyrga portseaensis (Gatliff & Gabriel, 1911): C Wickham (E) (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (WLM); Seal Pt (SGRDL)

Liostomia tasmanica (Tenison Woods, 1877): Fitzmaurice Bay (TMAG); KI (unlocalised) (JFM, WLM); Pass R Bay (TMAG)

Miralda montuosa Laseron, 1951: Fitzmaurice Bay (SGRDL, det. LS)

Miralda suprasculpta (Tenison Woods, 1878): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Pass R Bay (TMAG)

Odostomia crassicosta (May, 1916): Fitzmaurice Bay (TMAG)

Odostomia deplexa Tate & May, 1900: Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL); Halfmoon Bay (TMAG); Seal Pt (SGRDL)

Odostomia mayii (Tate, 1898): Fitzmaurice Bay (SGRDL)

Puposyrnola tasmanica (Tenison Woods, 1877): Fitzmaurice Bay (SGRDL)

Syrnola angasi (Tryon, 1886): Grassy Hbr (MRG)

Syrnola aurantiaca (Angas, 1867): Lt Porky Bch (SGRDL)

Syrnola metcalfei (Pritchard & Gatliff, 1900): Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (JFM); Pass R Bay (TMAG)
Syrnola tincta Angas, 1871: Colliers Bch (SGRDL); Fitzmaurice Bay (SGRDL)
Turbonilla fusca (A. Adams, 1855): Ettrick Bch (SGRDL); Seal Pt (SGRDL)
Turbonilla macleayana Tenison Woods, 1877: Currie Hbr (SGRDL); Fitzmaurice Bay (SGRDL)
Turbonilla mariae Tenison Woods, 1876: C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Halfmoon Bay (TMAG, MHR); KI (unlocalised) (JFM, TMAG, WLM); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL); Surprise Bay (MRG); Victoria Cove (MRG)
Turbonilla tasmanica Tenison Woods, 1875: Fitzmaurice Bay (SGRDL, TMAG); Lt Porky Bch (SGRDL); Pass R Bay (TMAG); Seal Pt (SGRDL)

Aplysiidae
Aplysia juliana Quoy & Gaimard, 1832: Grassy Hbr (MRG); Naracoopa (MRG)
Aplysia parvula Guilding in Mörch, 1863: Currie Hbr (MRG); Ettrick Bch (SGRDL); Grassy Hbr (MRG); KI (unlocalised) (QVMAG); Naracoopa (MRG)
Aplysia sydneyensis Sowerby, 1869: Sea Elephant Lagoon (MRG)

Haminoeidae
Haminoea maugeansis Burn, 1966: Ettrick Bch (SGRDL); Grassy Hbr (MRG); KI (unlocalised) (WLM); Naracoopa (MRG); Pass R Bay (TMAG); Seal Pt (SGRDL)

Aglajidae
Melanochlamys queritor (Burn, 1958): Naracoopa (MRG)

Cylichnidae
Adamnestia arachis (Quoy & Gaimard, 1833): Naracoopa (KIM)
Tornatina apicina Gould, 1859: Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM); Lt Porky Bch (SGRDL); Pass R Bay (TMAG)
Tornatina BURN sp 07: Colliers Bch (SGRDL)
Tornatina cf *hacketti* (Cotton & Godfrey, 1933): Colliers Bch (SGRDL)

Philinidae
Philine angasi (Crosse & Fischer, 1865): Cowper Pt, Sea Elephant Bay (SGRDL); KI (unlocalised) (WLM); Lavinia Bch (SGRDL); Naracoopa (SGRDL, KIM)

Retusidae
Retusa pelyx Burn in Burn & Bell, 1974: Elephant Shoal Reef (CJG); Fitzmaurice Bay (SGRDL, TMAG)

Runcinidae
Runcina australis Burn, 1963: Currie Hbr (MRG); Naracoopa (MRG)

Dotidae
Doto ostenta Burn, 1958: Currie Hbr (MRG)

Proctonotidae
Caldukia affinis (Burn, 1958): Grassy Hbr (MRG)
Janolus BURN sp 01: Naracoopa (MRG)

Aeolidiidae
Spurilla macleayi (Angas, 1864): Currie Hbr (MRG); Victoria Cove (MRG)

Scyllaeidae
Scyllaea pelagica Linnaeus, 1758: Currie Hbr (MRG); Naracoopa (MRG)

Tethydidae
Melibe australis (Angas, 1864): Currie Hbr (MRG)

Chromodorididae
Ceratosoma brevicaudatum Abraham, 1876: Currie Hbr (QVMAG)

Discodorididae
Hoplodoris nodulosa (Angas, 1864): Grassy Hbr (MRG)
Rostanga crawfordi (Burn, 1969): Grassy Hbr (MRG)
Sclerodoris tarka Burn, 1969: Grassy Hbr (MRG)

Doridiidae
Aphelodoris greeni Burn, 1966: Naracoopa (MRG)
Aphelodoris rossquicki Burn, 1966: Naracoopa (MV)
Neodoris chrysoderma (Angas, 1864): Naracoopa (MRG)

Onchidorididae
Onchidoris maugeansis (Burn, 1958): Grassy Hbr (MRG)

Dendrodorididae
Dendrodoris maugeana Burn, 1962: Naracoopa (MRG); Victoria Cove (MRG)
Doriopsilla miniata (Alder & Hancock, 1864): Naracoopa (MRG)

Gymnodorididae
Paliolla cooki (Angas, 1864): Grassy Hbr (MRG)

Pleurobranchidae
Berthella serenitas Burn, 1962: Grassy Hbr (MRG); Naracoopa (MRG)
Pleurobranchaea maculata (Quoy & Gaimard, 1832): Naracoopa (MRG)

Juliidae
Edenttellina typica Gatliff & Gabriel, 1911: Currie Hbr (MRG); Naracoopa (MRG)
Midorigai australis Burn, 1960: Naracoopa (MRG)
Tamanovalva babai Burn, 1965: Naracoopa (MRG)

Volvatellidae
Ascobulla fischeri (A. Adams & Angas, 1864): Naracoopa (MRG)

Limapontiidae
Placida dendritica (Alder & Hancock, 1843): Currie Hbr (MRG); Naracoopa (MRG)

Cavoliniidae
Clio pyramidata Linnaeus, 1767: Fitzmaurice Bay (SGRDL); Seal Pt (SGRDL)

Amphibolidae
Salinator fragilis (Lamarck, 1822): Sea Elephant Lagoon (MRG)

Phallomedusidae
Phallomedusa solida (von Martens, 1878): Sea Elephant Lagoon (MRG)

Siphonariidae
Pugillaria stowae (Verco, 1906): Colliers Bch (SGRDL); Ettrick Bch (SGRDL); Seal Pt (SGRDL); Surprise Bay (MRG); Victoria Cove (MRG)
Siphonaria diemenensis Quoy & Gaimard, 1833: Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); City of Melbourne Bay (SGRDL, TMAG); Currie Hbr (SGRDL, MRG); Disappointment Bay (SGRDL); E coast of KI (unlocalised) (TMAG); Ettrick Bch (SGRDL, TMAG, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy

(unlocalised) (TMAG); Grassy Hbr (SGRDL, MRG); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, TMAG, WLM); Lavinia Bch (SGRDL, TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG, MHR, MRG); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL, MRG); Victoria Cove (MRG); W coast of KI (unlocalised) (TMAG); Yellow Rock Bch (TMAG, MHR)

Siphonaria funiculata Reeve, 1856: Colliers Bch (SGRDL); Currie Hbr (SGRDL, MRG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL, MRG); Halfmoon Bay (TMAG, MHR); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, MRG); Pass R Bay (TMAG); Red Hut Pt (SGRDL); Surprise Bay (MRG); Yellow Rock Bch (MHR)

Ellobiidae

Leuconopsis pellucidus (Cooper, 1841): Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); KI (unlocalised) (WLM)

Marinula parva (Swainson, 1856): KI (unlocalised) (WLM)

Marinula xanthostoma A. Adams & H. Adams, 1855: Black Pt, Seal Bay (SGRDL); British Admiral Bch (TMAG); C Wickham (E) (SGRDL); Currie Hbr (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); Halfmoon Bay (MHR); KI (unlocalised) (JFM, QVMAG, WLM); Lt Porky Bch (SGRDL); Naracoopa (SGRDL); Pass R Bay (TMAG); Porky Bch (SGRDL); Red Hut Pt (SGRDL); Surprise Bay (SGRDL); W coast of KI (unlocalised) (TMAG)

Trimusculidae

Trimusculus conicus Angas, 1864: Colliers Bch (SGRDL); Currie Hbr (SGRDL); Fitzmaurice Bay (TMAG); Halfmoon Bay (MHR); Sandblow Bay, Grassy Hbr (SGRDL)

CEPHALOPODA

Argonautidae

Argonauta nodosus Solander, 1786: KI (unlocalised) (KIM); Naracoopa (TMAG)

Octopodidae

Hapalochlaena maculosa (Hoyle, 1883): KI (unlocalised) (QVMAG); Naracoopa (MRG)

Octopus maorum Hutton, 1880: KI (unlocalised) (MV)

Octopus superciliosus Quoy & Gaimard, 1832: Bass Strait NE of KI, scallop survey site 01 (TMAG)

Octopus warringa Stranks, 1990: Bass Strait NE of KI, scallop survey site 02 (TMAG); Bass Strait NE of KI, scallop survey site 04 (TMAG); Currie Hbr (MRG)

Sepiidae

Sepia apama Gray, 1849: Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); C Wickham (E) (SGRDL); City of Melbourne Bay (TMAG); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL, TMAG); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); KI (unlocalised) (WLM); Lavinia Bch (SGRDL, TMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Yellow Rock Bch (SGRDL, TMAG)

Sepia braggi Verco, 1907: Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); City of Melbourne Bay (SGRDL); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Disappointment Bay (SGRDL); Grassy Hbr (SGRDL); Lavinia Bch (SGRDL); Naracoopa (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Yellow Rock Bch (SGRDL)

Sepia cultrata Hoyle, 1885: Ettrick Bch (SGRDL); KI (unlocalised) (WLM); Sandblow Bay, Grassy Hbr (SGRDL)

Sepia hedleyi Berry, 1918: Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); City of Melbourne Bay (SGRDL, TMAG); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Fitzmaurice Bay (SGRDL); Grassy Hbr (SGRDL); Lavinia Bch (SGRDL, TMAG); Naracoopa (SGRDL); Pass R Bay (TMAG); Sandblow Bay, Grassy Hbr (SGRDL); Seal Pt (SGRDL); Surprise Bay (SGRDL); Yellow Rock Bch (SGRDL, TMAG)

Sepia novaehollandiae Hoyle, 1909: Black Pt, Seal Bay (SGRDL); Blowhole, Sea Elephant Bay (SGRDL); British Admiral Bch (TMAG); City of Melbourne Bay (SGRDL, TMAG); Colliers Bch (SGRDL); Cowper Pt, Sea Elephant Bay (SGRDL); Currie Hbr (SGRDL); Disappointment Bay (SGRDL); Ettrick Bch (SGRDL); Fitzmaurice Bay (SGRDL, TMAG); Grassy Hbr (SGRDL); Gulchway, Stokes Pt (SGRDL); Lavinia Bch (SGRDL, TMAG); Lt Porky Bch (SGRDL); Naracoopa (SGRDL, TMAG); Pass R Bay (TMAG); Porky Bch (SGRDL); Sandblow Bay, Grassy Hbr (SGRDL); Surprise Bay (SGRDL); Yellow Rock Bch (SGRDL, TMAG)

Spirulidae

Spirula spirula Linnaeus, 1758: Currie Hbr (SGRDL); Fitzmaurice Bay (TMAG); KI (unlocalised) (JFM); Lavinia Bch (SGRDL); Naracoopa (KIM)

COASTAL EROSION REVEALS A POTENTIALLY UNIQUE OLIGOCENE AND POSSIBLE PERIGLACIAL SEQUENCE AT PRESENT-DAY SEA LEVEL IN PORT DAVEY, REMOTE SOUTH-WEST TASMANIA

by Mike Macphail, Chris Sharples, David Bowman, Sam Wood & Simon Haberle

(with two text-figures, five plates and two tables)

Macphail, M., Sharples, C., Bowman, D., Wood, S. & Haberle, S. 2014 (19:xii): Coastal erosion reveals a potentially unique Oligocene and possible periglacial sequence at present-day sea level in Port Davey, remote South-West Tasmania. *Papers and Proceedings of the Royal Society of Tasmania* 148: 43–59. ISSN 0080-4703 Department of Archaeology & Natural History, College of Asia and the Pacific, Australian National University, Canberra, ACT 0200, Australia (MM*, SH); School of Geography & Environmental Studies, Faculty of Science, Engineering & Technology, University of Tasmania, Hobart, Tasmania 7001 Australia (CS); School of Biological Sciences, Faculty of Science, Engineering & Technology, University of Tasmania, Hobart, Tasmania 7001 Australia (DB, SW). *Author for correspondence. Email: mike.macphail@anu.edu.au

Cut-back of a sea-cliff at Hannant Inlet in remote South-West Tasmania has exposed Oligocene clays buried under Late Pleistocene "colluvium" from which abundant wood fragments protrude. The two units are separated by a transitional interval defined by mixed Oligocene and Pleistocene microfloras. Microfloras preserved *in situ* in the clay provide a link between floras in Tasmania and other Southern Hemisphere landmasses following onset of major glaciation in East Antarctica during the Eocene-Oligocene transition (c. 34 Ma). The Late Pleistocene "colluvium" preserves abundant fossil pollen of the shrub conifer genus *Pherosphaera* (al. *Microstrobos*). Assuming the parent plants had the same upper subalpine-alpine ecology as living *Pherosphaera hookeriana*, the microflora provides evidence for cold, wet conditions in the Port Davey lowlands during a low sea-level stand. The same data highlight the failure of *Pherosphaera* to regain its Pleistocene distribution during the Postglacial period. Our data are inconclusive whether Late Pleistocene conditions in Hannant Inlet were periglacial, i.e., the Oligocene sediments were turbated by freeze-thaw processes, or have been reworked by fluvial processes into the Pleistocene "colluvium". Nevertheless, the inferred cold-climate is consistent with the former hypothesis. The sequence is sealed under cross-bedded coarse quartzite gravels of presumed Last Glacial Stage age.

Key Words: Cenozoic palynostratigraphy, Tasmania, Antarctica, South America, Oligocene, Pleistocene, *Lophosoria*, *Embothrium*, *Pherosphaera*, trans-oceanic migration

INTRODUCTION

Eroding coastlines have played a decisive role in our understanding of geological time and ancient life – from the world-famous Siccar Point Unconformity on the Berkshire coast (UK), where in 1788 one of the "fathers of geology" James Hutton first demonstrated the immensity of geologic time (Toghill 2000), to Happisburgh on the Norfolk coast, which preserves evidence that palaeohumans had migrated into northwest Europe by c. 840 ka (Parfitt *et al.* 2010). Evidence of past human occupation is preserved close to sea level around Tasmania, e.g., engravings on rock outcrops at Preminghana (Mt Cameron West) and Sundown Point on the West Coast (Sims 2013), but the majority of coastal exposures archive much earlier geological and biological events. Examples are the "Great Unconformity", which separates folded Silurian-Devonian slates and horizontally-bedded Permian mudstones on the east coast of Maria Island (fig. 1.3 in Corbett 2014), Pleistocene fossil logs, some in apparent growth position at Cox Bight on the far South Coast (Bowman *et al.* 2013), and possible ice-wedge structures at Rocky Cape on the North-West Coast (Colhoun 1977). Such exposures often are difficult to reach, let alone analyse, but continuing marine cut-back of exposed shoreline deposits means that any associated plant macrofossils and microfossils usually are as well preserved as those recovered from unweathered shales and mudstones in drillcore.

In this paper we describe and illustrate microfloras preserved in recently-exposed Late Paleogene sandy clays and Pleistocene "colluvium" in an eroding sea-cliff at Hannant Inlet in Port Davey on the remote South-West Coast of Tasmania (fig. 1). The sandy clays (Unit A) are sequentially overlain by (i) a Pleistocene gravelly clay colluvium (Unit B) from which numerous large horizontally-bedded wood fragments protrude (pls 1, 2) and (ii) apparently cross-bedded coarse quartzite gravels of presumed Last Glacial Stage age (Unit C). Palynostratigraphic evidence (this study) shows the two lower units are separated by a turbated interval distinguished only (MM) by a mixed assemblage of microfossils that otherwise are restricted to either Unit A or to Unit B. Some of the microfossils are the first record of the fossil plant genus (morphogenus) or species (morphospecies) in southern Tasmania. The site, which was previously discovered by geologist Grant Dixon and recorded on the Tasmanian Geoconservation Database maintained by the Tasmanian Department of Primary Industries, Parks, Water & Environment, was sampled in February 2010 by DB, CS and SW. As is typical in remote South-West Tasmania, it can only be reached by an arduous two-day bushwalk or by boat from Melaleuca Inlet c.10 km to the east of Port Davey. Hannant Inlet is an integral part of the South-West National Park and World Heritage Area, and the site augments the already impressive geoheritage values of the Area.

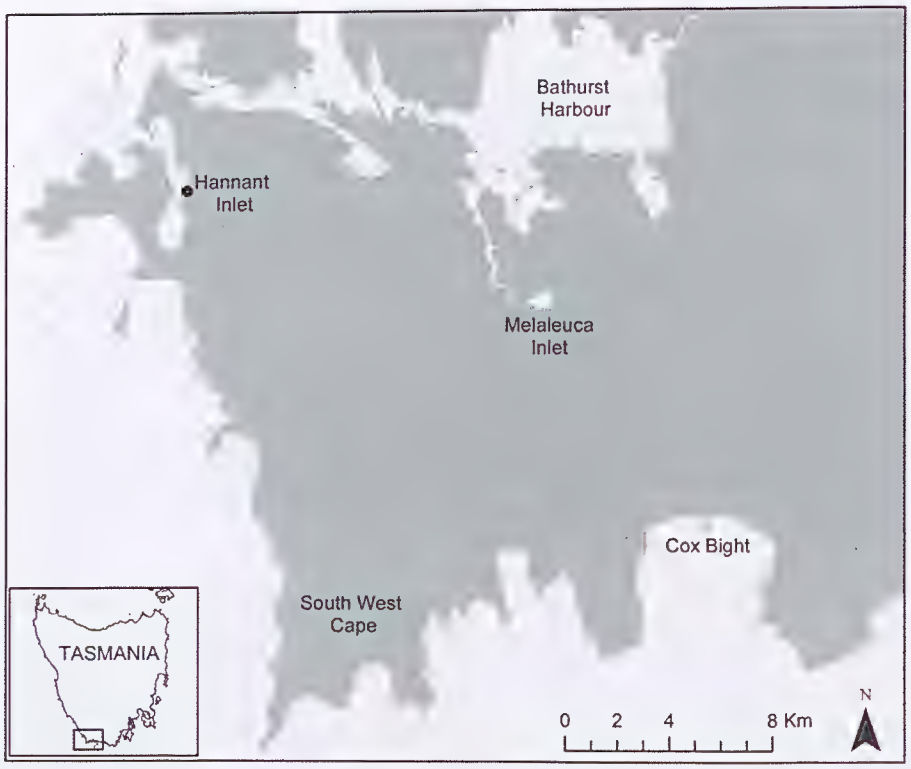

FIG. 1 — Locality map.

PHYSICAL SETTING

The physical landscape of the Melaleuca–Port Davey region is dominated by extensive lowland buttongrass moorland, and surrounded by the mountains and ranges of the South-West National Park and the expansive interconnected waterways of Port Davey, Bathurst Channel and Bathurst Harbour (Parks and Wildlife Service, Tasmania 2003). Marine fauna in the harbour is unusual in that some taxa are relict, with the closest analogous communities occurring in Milford Sound in New Zealand and in Tierra del Fuego in southern South America. The shallow estuarine complex occupies a drowned river system (ria) incised into deformed, low- to medium-grade metamorphosed Precambrian rocks, chiefly quartzites, phyllites and schists. The youngest sedimentary rocks in the area are relatively un-metamorphosed conglomerates, sandstones and shales of the Proterozoic Clytie Cove Group (Williams & Corbett 1977, Williams 1981, 1982).

Higher mountains in the South-West National Park, e.g., Federation Peak (1224 m elevation) and Mt La Perouse (1157 m elevation) were glaciated on several occasions during the Pleistocene and the regional snowline during the Last Glacial Maximum c. 20 ka ago was as low as 600 m elevation (cf. Colhoun *et al.* 2014). The nearest evidence of Pleistocene glaciation to Hannant Inlet is on Mt Norold (822 m elevation) located c. 25 m ENE of Hannant Inlet (Stefanski 1957) but there is no evidence that glaciers developed on other ranges in the Melaleuca–Port Davey region or extended onto the coastal lowlands during the Last or earlier Quaternary Glacial Stages. In contrast, it is highly probable that the region experienced severe freeze-thaw (periglacial) conditions during glacial and stadial episodes (references in Colhoun *et al.* 2014). During periods of glacio-eustatic low sea levels, the ria becomes a chain of shallow valleys that are connected by deeper channels incised into the bedrock by streams draining mountainous terrain to the north, east and south. At these times, the coastal plain around Port Davey extended seaward of the present shoreline by c. 7–15 km depending whether the palaeo-coastline is placed at the 100 m depth- or 150 m depth-contours, respectively.

The present-day climate is cool and wet (microtherm, perhumid), with evapo-transpiration further reduced by the high incidence of cloud cover. Abundant rainfall and repeated anthropogenic wildfires have allowed buttongrass (*Gymnoschoenus sphaerocephalus* (R.Br.) Hook.f. moorland to expand from the poorly drained valley flats onto the upper slopes of most ranges; wildfires have restricted woody communities to fire-protected sites such as deeper gullies, southeast facing slopes, islands within Bathurst Harbour, and coastal wetlands surrounding creeks and lagoons (see Wood *et al.* 2011a, 2011b). These wet communities include: (i) rainforest scrub, mixed-forest and closed rainforest types dominated by *Nothofagus cunninghamii* (Hook.) Oerst, *Phyllocladus asplenifolius* (Labill.) Hook.f., *Eucryphia lucida* (Labill.) Baill., *Atherosperma moschatum* Labill. and *Anopterus glandulosus* Labill., gallery rainforest dominated by *Lagarostrobos franklinii* (Hook.f.) Quinn, wet sclerophyll scrub dominated by *Leptospermum* or *Melaleuca* with a sparse overstorey of *Eucalyptus nitida* Hook.f. and (ii) *Eucalyptus nitida* wet sclerophyll forest in which *Nematolepis squamea* (Labill.) P.G.Wilson and *Pittosporum bicolor* Hook. are common and where rainforest species, tall sedges (*Gahnia grandis* (Labill. S.T.Blake)) and ferns such as *Pteridium esculentum* (G.Forst.) Cockayne also may occur. Lowland herbaceous communities are mostly confined to the coastal plain and include small areas of Chenopodiaceae-dominated saltmarsh within the estuaries.

PLATE 1 — View of sea-cliff at Hannant Inlet (photograph by C. Sharples).

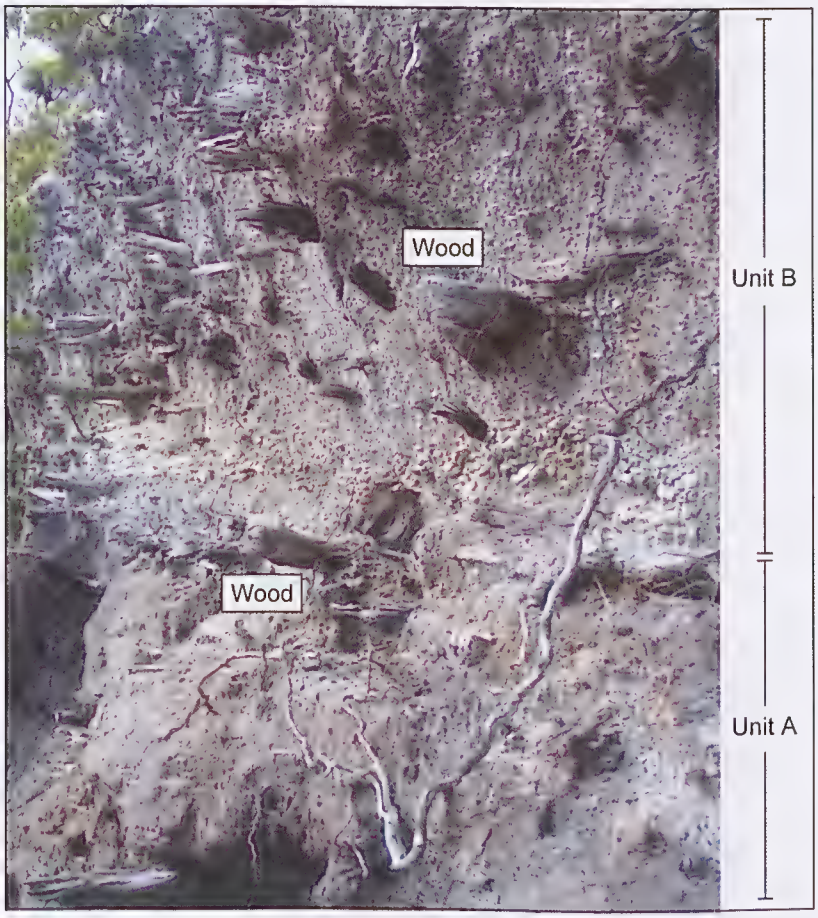

PLATE 2 — Close up view of Hannant Inlet section showing sampled facies (photograph by C. Sharples).

None of the mountain ranges in the Melaleuca–Port Davey area rise above the climatic limit for tree-growth in southern Tasmania but cold climate floras including *Astelia* and *Microcachrys* occur on some of the summit ridges on Mt Norold, Mt Rugby (734 m elevation) Mt Council (801 m elevation) and the South-West Cape Range, (684 m elevation), presumably as a result of exposure to extreme winds. *Pherosphaera hookeriana* W.Archer bis occurs in subalpine-alpine environments at elevations above 1000 m on Mt Anne and Precipitous Bluff c. 60 km to the NE and WSW of Hannant Inlet, respectively (fig. 2). Based on data from 26 collection localities, the climate preferences of this shrub conifer include a mean annual temperature of 7.5°C, with an average minimum in the coldest month of 0.1°C, and a mean annual precipitation of 1613 mm (Brown *et al.* 1983, Biffen *et al.* 2011).

Hannant Inlet

The inlet, which occupies a north-south-trending depression eroded into Precambrian metasediments, is bounded to the east by the South-West Cape Range and to the west by a complex peninsula of low hills and bedrock outcrops (maximum elevation 117 m) overlain by Quaternary alluvium and colluvium. As with other shallow inlets in Port Davey, the embayment is marine only during periods of high relative sea levels, and the present shoreline is likely to have developed only after sea levels stabilised around their present position some 6 ka ago. For example, the southwest end of the Inlet is separated from the open ocean (Stephens Bay) by tidal flats, mud banks and partly stable transgressive sand dunes. The deposits of "bedded gravels and cobbles" outcropping midway down the eastern shoreline in the inlet and putatively identified as a raised beach by Williams (1982), is our Unit C in the Hannant Inlet sea-cliff. Imbricate gravels on the opposite (western) shore of the inlet are different from Unit C and other putative raised beach deposits mapped in the Port Davey; their presumed Pleistocene age has yet to be confirmed (C. Sharples unpubl. observations). In contrast, palaeochannel sediments and peats at Melaleuca Inlet, which preserve the micro- and macrofossil remains of sclerophyll and rainforest plants, are known to date to the Late Pleistocene and/or Holocene (Jordan & Hill 1991, Jordan *et al.* 1991, Thomas 1995, Macphail *et al.* 1999). Soil around the buried logs at Cox Bight preserves pollen of the cold climate shrub conifers *Pherosphaera*, *Microcachrys*, Ericaceae and an Asteraceae (*Cassinia arcuata*-type) now restricted to mainland Australia (Bowman *et al.* 2013). As far as we know, sites analogous to the Hannant Inlet outcrop have not been found on the South-West Coast or elsewhere around the Tasmanian coastline.

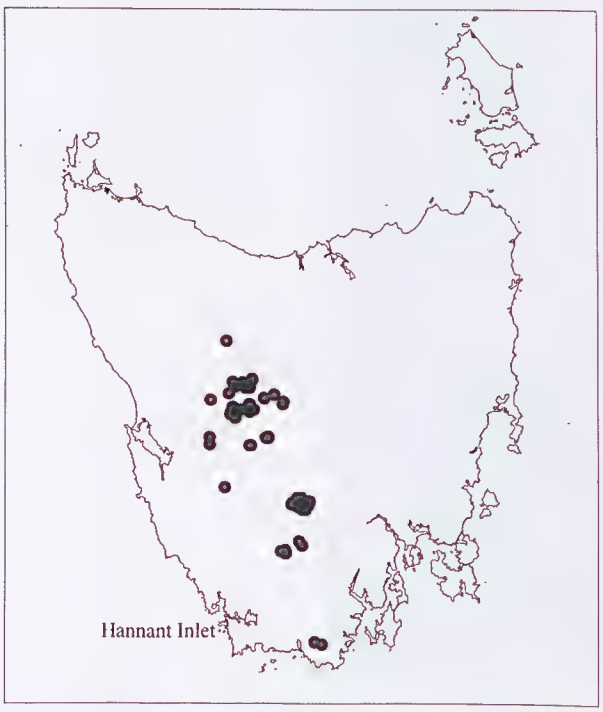

FIG. 2 — Present-day distribution of *Pherosphaera hookeriana* (after Brown *et al.* 1983).

Site details

The fossiliferous sediments outcrop near the base of a c. 20 m high sea-cliff at 43.3694°S 145.9987°E (GPS point, GDA94 datum), located approximately midway along the eastern shoreline of the inlet. The section could not be formally measured because of its remote location and time constraints, but cursory field observations (CS) suggest that the lower units had only been recently exposed by wave action. At this time, the visible lithostratigraphy comprised three units (heights measured relative to high water mark are approximate only):

4.5–15 m AHD (Unit C) coarse cross-bedded quartzite gravels lacking organic remains.

0.5–4.5 m AHD (Unit B) coarsely bedded gravelly clays with horizontally-bedded and aligned wood fragments.

0.0–0.5 m AHD (Unit A): sandy clays lacking obvious plant remains.

For the purposes of this paper we have adopted the neutral position that Units B and C are "colluvium" although we recognise the sedimentary architecture of these units implies both may be alluvial fan units deposited in relatively high energy fluvial environments. Palynological evidence (this paper) indicates the gravelly clays (Unit B) and underlying sandy clays (Unit A) are separated by a turbated interval that includes a thin layer of water-worn pebbles. Field observations suggest this interval is the basal stratum in Unit B, consistent with palynostratigraphic evidence showing clay overlying the pebble layer preserves a mixed Paleogene/ Pleistocene microflora (table 1). This could be due to fluvial processes reworking palynomorphs from the underlying sandy clays. However, an alternative interpretation is that the interval is a separate unit (solifluction deposit) emplaced under periglacial (freeze-thaw) conditions. Microfossil data indicate that Unit A, initially identified as a palaeosol (Bowman *et al.* 2013), is more likely to have accumulated in a mire on the eastern side of the Hannant Inlet palaeovalley.

TABLE 1 — Stratigraphic distribution of plant microfossils at Hannant Inlet and Fossil Bluff, Wynyard

Fossil taxon	Nearest living relative [genus/family]	Hannant Inlet 3	Hannant Inlet 2	Hannant Inlet 1	Fossil Bluff
Pollen count		531	434	310	800
CRYPTOGAMS, GYMNOSPERMS					
Algae, mosses, liverworts					
Baculatisporites spp.	Hepaticae		1%	1%	x
Botryococcus	*Botryococcus*	+		+	
Bryosporis	Musci	x	x	+	
Stereisporites australis	*Sphagnum* (Sphagnaceae)		+	3%	x
Ferns & fern allies					
Baculatisporites disconformis	Hymenophyllaceae		x	x	2%
Cyatheacidites annulatus	*Lophosoria* (Lophosoriaceae)		+		+
Cyathidites australis/minor	Cyatheaceae	x	x	+	
Cyathidites paleospora	*Cyathea* (Cyatheaceae)		x		10%
Cyathidites subtilis	*Cyathea* (Cyatheaceae)			cf.	x
Dictyophyllidites arcuatus	Gleicheniaceae				+
Foveotriletes balteus	*Lycopodium* sensu lato (Lycopodiales)			x	
Foveotriletes lacunosus	*Lycopodium*			x	
Foveotriletes palaequetrus	*Lycopodium* sensu lato (Lycopodiales)			x	
Herkosporites elliottii	*Lycopodium deuterodensum*-type (Lycopodiaceae)		x	x	x
Ischyosporites cf *lachlanensis*	Dicksoniaceae?				6%
Gleicheniidites spp.	Gleicheniaceae	30%	x	+	
Kuylisporites waterbolkii	*Hemitelia*-type (Cyatheaceae)				+
Laevigatosporites ovatus/major	Blechnaceae, Schizaeaceae		+	1%	1%
Latrobosporites crassus	Lycopodiales		x		
Latrobosporites marginis	*Lycopodiella lateralis* (Lycopodiaceae)	+	+	x	x
Matonisporites ornamentalis	*Dicksonia antarctica* (Dicksoniaceae)				2%
Monolites alveolatus	*Belvisia*-type (Polypodiaceae)			+	
Ophioglossisporites lacunosus	*Ophioglossum/Phylloglossum*	x		x	
Peromonolites vellosus	Blechnaceae?			+	x
Polypodiaceoisporites cf. *retirugatus*	*Pteris* (Adiantaceae)		x	+	
Polypodiisporites histiopteroides	*Histiopteris incisa* (Dennstaedtiaceae)		x	x	x
Polypodiisporites spp.	Davalliaceae/Polypodiaceae				x
Rugulatisporites spp.	*Calochlaena* (Thyrsopteridaceae)			1%	x
Trilites tuberculiformis	Dicksoniaceae		x	x	x
Verrucosisporites cristatus	*Lygodium* (Schizaeaceae)		x	x	
Verrucosisporites kopukuensis	*Lygodium* (Schizaeaceae)	x	+	x	
Gymnosperms					
Araucariacites australis	*Araucaria* (Araucariaceae)		+	1%	8%
Araucariacites cf. *australis*	*Agathis* (Araucariaceae)				+
Cupressacites	Cupressaceae/Taxodiaceae	+	x		+
Dacrycarpites australiensis	*Dacrycarpus* (Podocarpaceae)		+	+	+
Dacrydiumites florinii	*Dacrydium* (Podocarpaceae)		5%	6%	5%
Dilwynites granulatus	*Agathis/Wollemia* (Araucariaceae)			x	
Microalatidites palaeogenicus	*Phyllocladus* (Podocarpaceae)	1%	2%	2%	2%
Microcachryidites antarcticus	*Microcachrys* (Podocarpaceae)	+	1%	+	
Phyllocladidites mawsonii	*Lagarostrobos* (Podocarpaceae)	3%	12%	6%	3%
Parvisaccites catastus	*Dacrydium bidwillii*-type (Podocarpaceae)		+	+	x
Podocarpidites spp.	*Podocarpus/Prumnopitys*(Podocarpaceae)		19%	8%	7%
Podosporites sp (bald sacci)	*Podocarpus/Prumnopitys* (Podocarpaceae)			1%	
Podosporites erugatus	*Pherosphaera/Microstrobos* (Podocarpaceae)	15%	10%		x
Podosporites parvus/ microsaccatus	cf. *Microcachrys* (Podocarpaceae)		2%		+

TABLE 1 (cont.) — Stratigraphic distribution of plant microfossils at Hannant Inlet and Fossil Bluff, Wynyard

Fossil taxon	Nearest living relative [genus/family]	Hannant Inlet 3	Hannant Inlet 2	Hannant Inlet 1	Fossil Bluff
ANGIOSPERMS					
Angiosperms (herbaceous taxa)					
Aglaoreidia qualumis	Typhaceae?				x
Arecipites spp.	cf. Arecaceae			x	x
Chenopodipollis chenopodiaceoides	Amaranthaceae-Chenopodiaceae	+			x
Cyperaceaepollis	Cyperaceae	1%	x	+	+
Droseridites sp.	*Drosera* (Droseraceae)	x	x		
Graminidites	Poaceae	x			
Liliacidites bainii	Arecaceae/Liliaceae			x	
Liliacidites spp.	Liliales		1%	4%	x
Luminidites sp.	cf. *Dianella* (Liliaceae)			x	
Milfordia hypolaenoides	Restionaceae	20%	+	+	x
Periporopollenites vesicus	Caryophyllaceae?				x
Polycolpites sp.	*Wahlenbergia* (Campanulaceae)				
Striacolporites	*Scaevola*-type (Goodeniaceae)				
Tricolpites stylidioides	*Stylidium* (Stylidiaceae)	x			
Tricolpites sp. A	Brassicaceae	1%			
Tricolporites sp. A	*Dichosciadium* (Apiaceae)	+			
Tricolporites sp. B	Apiaceae-type	+	+		
Angiosperms (woody and unassigned taxa)					
Acaciapollenites myriosporites	*Acacia* (Mimosaceae)		x		
Ailanthipites paenestriatus	includes Anacardiaceae		x	+	x
Banksieaeidites sp. cf. *serrata*	*Banksia serrata*-type (Proteaceae)		x		x
Beaupreaidites elegansiformis	*Beauprea* (Proteaceae)		x	+	x
Beaupreaidites verrucosus	*Beauprea* (Proteaceae)			x	
Bluffopollis scabratus	Strasburgeriaceae			x	
Canthiumidites cf. *oblatus*	*Canthium sensu lato* (Rubiaceae)		x	cf.	
Clavatipollenites glarius	*Ascarina* (Chloranthaceae)			cf.	+
Concolpites leptos	*Gillbeea*-type (Cunoniaceae)				x
Crotonipollis sp.	*Ricinocarpos* (Euphorbiaceae)	+			
Cupanieidites orthoteichus	Sapindaceae tribe Cupanieae			+	
Granodiporites nebulosus	*Embothrium* (Proteaceae)		x	?	x
Gyropollis psilatispora	Gyrostemonaceae			x	
Ericipites sp A	*Sprengelia*-type (Epacridaceae)	1%	1%	x	
Ericipites spp.	Epacridaceae-Ericaceae	3%	3%	2%	+
Gyropollis psilatus	Gyrostemonaceae				
Haloragacidites harrisii	Casuarinaceae	19%	10%	11%	6%
Ilexpollenites anguloclavatus	*Ilex* (Aquilifoliaceae)				x
Monotocidites galeatus	*Monotoca* (Euphorbiaceae)	+	1%	+	
Monotocidites sp.	*Leucopogon* (Euphorbiaceae)				
Myrtaceidites eucalyptoides	*Eucalyptus sensu lato* (Myrtaceae)	+	1%		x
Myrtaceidites leptospermoides	*Leptospermum*-type (Myrtaceae)	+		cf.	
Myrtaceidites cf. *lipsis*	*Eucalyptus* (Myrtaceae)	+			
Myrtaceidites parvus-mesonesus	Myrtaceae		2%	+	x
Myrtaceidites verrucosus	*Austromyrtus*-type (Myrtaceae)		x		x
Myrtaceidites sp. A	*Melaleuca*-type (Myrtaceae)		x		
Nothofagidites asperus	*Nothofagus*(*Lophozonia*) spp. e.g. *N. cunninghamii*	1%	x	3%	4%
Nothofagidites brachyspinulosus	*Nothofagidites* (*Fuscospora*) spp. e.g. *N. gunnii*	+	1%	3%	2%
Nothofagidites emarcidus-heterus	*Nothofagus*(*Brassospora*) spp. (Nothofagaceae)		15%	18%	34%
Nothofagidites falcatus	*Nothofagus*(*Brassospora*) spp. (Nothofagaceae)		1%	2%	+
Nothofagidites flemingii	*Nothofagus*(*Brassospora*) spp. (Nothofagaceae)		+	x	x
Nothofagidites vansteenisii	*Nothofagus*(*Brassospora*) spp. (Nothofagaceae)			cf.	x
Nuxpollenites sp.	*Dodonaea-triquetra*-type (Sapindaceae)		x		x

TABLE 1 (cont.) — Stratigraphic distribution of plant microfossils at Hannant Inlet and Fossil Bluff, Wynyard

Fossil taxon	Nearest living relative [genus/family]	Hannant Inlet 3	Hannant Inlet 2	Hannant Inlet 1	Fossil Bluff
Palaeocoprosmadites zelandiae	*Coprosma*-type (Rubiaceae)	x			
Paripollis sp.	*Epacris* (Epacridaceae)	x			
Poluspissusites ramosus	Goodeniaceae	x	x		
Polycolpites sp. sp.	unknown		1%	x	
Propylipollis annularis	*Xylomelum* (Proteaceae)		x	x	x
Proteacidites obscurus	*Agastachys* (Proteaceae)		1%	3%	x
Proteacidites persoonioides ms	*Persoonia* (Proteaceae)	+			
Proteacidites scaboratus	Proteaceae		x	x	
Proteacidites stipplatus	Proteaceae		1%	x	
Proteacidites tuberculatus	Proteaceae				x
Proteacidites spp.	Proteaceae		2%	2%	x
Pseudowinterapollis cranwellae	*Tasmannia* (Winteraceae)	+	x		x
Psiladiporites sp.	*Alyxia* (Apocynaceae)				x
Quintiapollis psilatispora	*Quintinia* (Grossulariaceae)			x	x
Rhoipites ampereaformis	*Amperea* (Euphorbiaceae)	+	x		x
Rhoipites sp.	Apiaceae				
Rhoipites spp.	includes Rutaceae		+	+	x
Rubipollis oblatus	*Canthium*-type	x			x
Sapotaceoidaepollenites rotundus	Sapotaceae			x	
Spinitricolporites	unknown angiosperm			x	
Stephanocolpites oblatus	*Haloragodendron/Glischrocaryon* (Haloragaceae)		x		
Tetracolporites palynius	cf. *Alectryon*		cf.	x	
Tricolpites sp. B	*Hibbertia*-type (Dilleniaceae)	x			
Tricolpites spp.	numerous families		2%	3%	
Tricolporites leuros	unknown				x
Tricolporites sp. C	*Anopterus/Donatia* (Escalloniaceae/Donatiaceae)			x	
Tricolporites sp. D	*Pomaderris apetala* (Rhamnaceae)	+			
Tricolporites spp.	numerous families		+	+	+
Tricolporopollenites endobalteus	*Mallotus*-type (Euphorbiaceae)			x	
Triporopollenites ambiguus	*Telopea* (Proteaceae)				x
Tubulifloridites antipoda	Tubuliflorae (Asteraceae)	1%			
Tubulifloridites pleistocenicus	*Cassinia arcuata*-type (Asteraceae)	+			
Tubulifloridites simplis	Tubuliflorae (Asteraceae)	1%			

PALYNOSTRATIGRAPHY

One sample collected from each of the two main sedimentary units and one from the "turbated" interval were taken for palynostratigraphic analysis, i.e., from within Unit A (Sample 1), from the "turbated" interval near the apparent base of Unit B (Sample 2), and from the clay matrix surrounding a piece of wood mid-section within Unit B (Sample 3). Pieces of wood from Unit B were collected for AMS radiocarbon dating and to determine whether the source could be identified. Results of the latter were inconclusive although a gymnosperm origin seems likely.

Trial processing (SH) of samples sent to the Australian National University revealed the basal sandy clay (unit A) was considerably older than the Holocene to Last Interglacial age predicted for the sequence at the time of sampling. Additional sub-samples (MM) were reprocessed for pollen, spores (miospores) and other plant microfossils by Core Laboratories (Australia) using standard techniques of oxidation and microfiltration (see Traverse 1988). Palynostratigraphic criteria used to infer the maximum, preferred and minimum age limits of Units A and B are based on morphospecies time-distributions in the offshore Gippsland and Bass Basins in Bass Strait, Victoria (Partridge 1999, 2006; A.D. Partridge & M.K. Macphail unpubl. data). Geological ages (Ma) are in accordance with the revised timescale of Ogg *et al.* (2008). Where possible, fossil species are cited under their fossil (morphospecies) names, with the nearest known living relatives (NLRs) given in parentheses. A selection of age-diagnostic, phytogeographically significant, and previously unrecorded morphospecies are illustrated in pls 3–5.

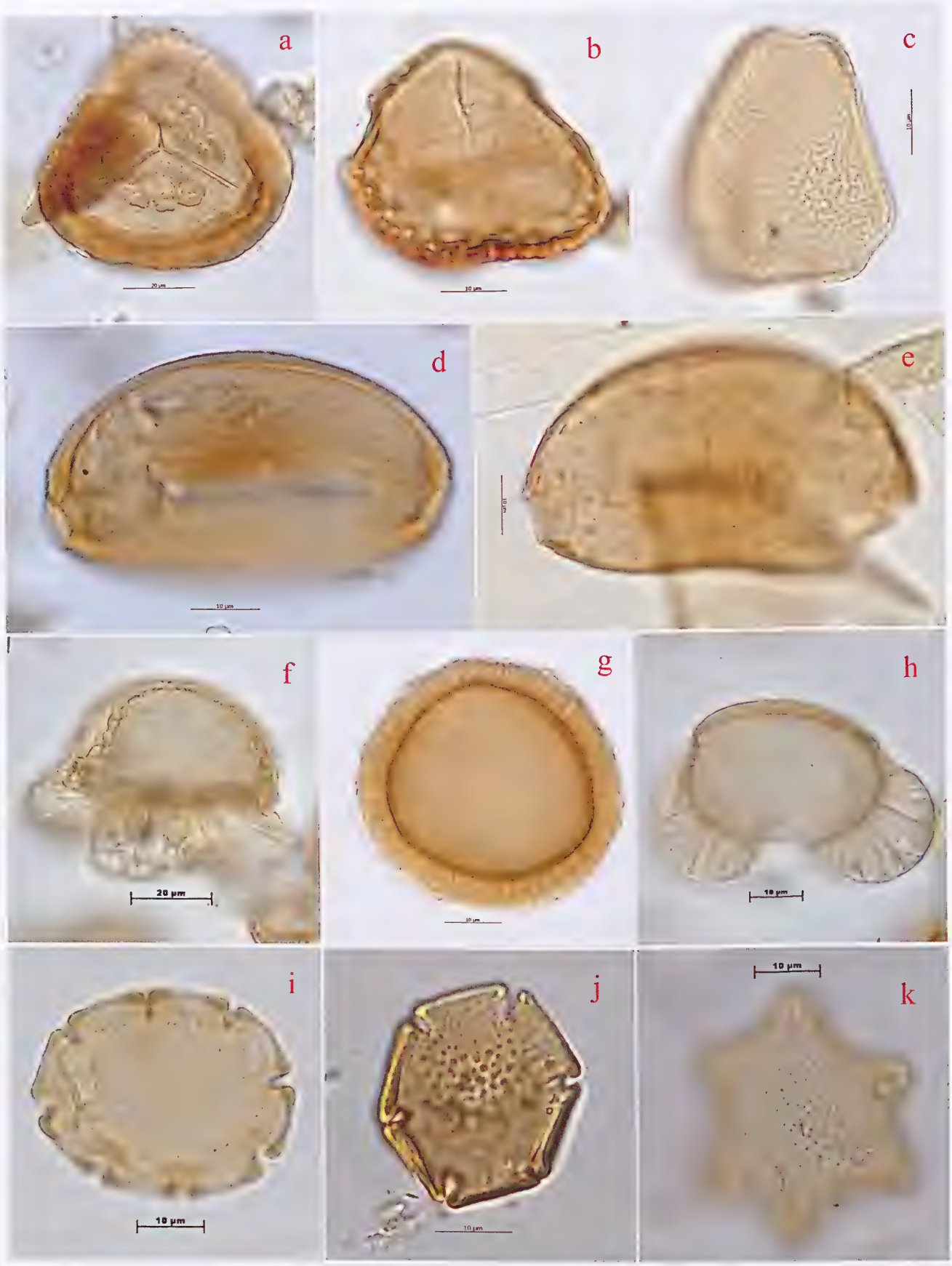

PLATE 3 — Age-diagnostic morphospecies preserved in Unit A (Sample 1) a. *Cyatheacidites annulatus* (*Lophosoria*); b. *Foveotriletes palaequetrus* (*Lycopodium*); c. *Proteacidites stipplatus* (extinct Proteaceae clade); d & e. *Granodiporites nebulosus* (*Embothrium*); f. *Dacrycarpites australiensis* (*Dacrycarpus*); g. *Dacrydiumites florinii* (*Dacrydium*): h. *Parvisaccites catastus* (*Lagarostrobos bidwilliii biforme*); i. *Nothofagidites flemingii* [*Nothofagus* (*Nothofagus*) spp.]; j. *Nothofagidites emarcidus* [*Nothofagus* (*Brassospora*) spp.]; k. *Nothofagidites falcatus* [*Nothofagus* (*Fuscospora*) spp.]

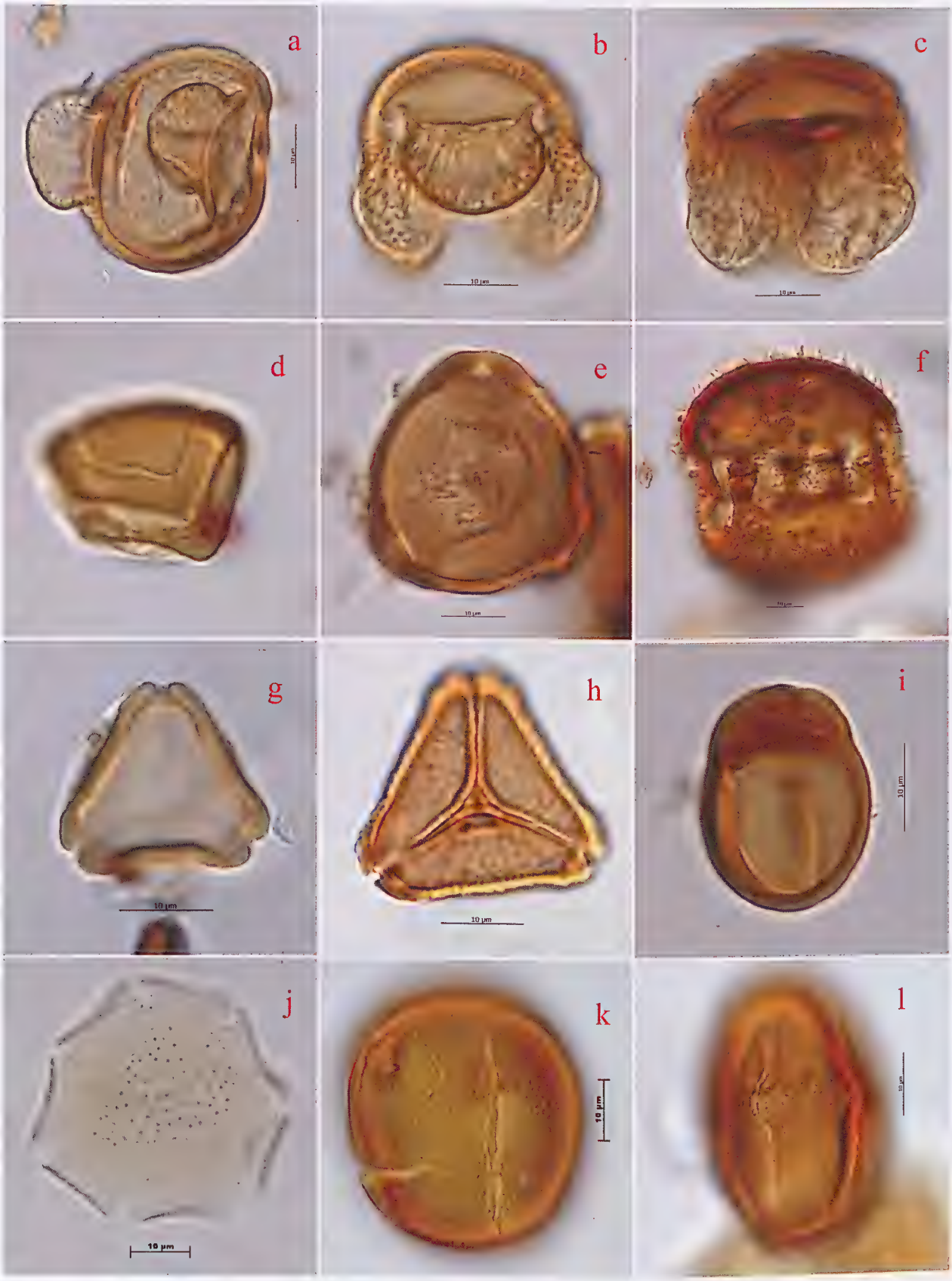

PLATE 4 — Morphospecies recorded in Unit B (Sample 3). Equivalent fossil morphospecies in parentheses. a. *Lagarostrobos franklinii* (*Phyllocladidites mawsonii*); b. *Pherosphaera hookeriana* (*Podosporites erugatus*); c. *Microcachrys tetragona* (*Microcachryidites antarcticus*); d. *Acacia* monad (*Acaciapollenites myriosporites*); e. *Allocasuarina/Casuarina* (*Haloragacidites harrisii*); f. *Drosera* (*Droseridites* sp.); g. *Eucalyptus* (*Myrtaceidites eucalyptoides*); h. *Melaleuca squamea*-type (*Myrtaceidites* cf. *verrucosus*); i. *Monotoca* (*Monotocidites galeatus*); j. *Nothofagus cunninghamii* (*Nothofagidites asperus*); k. cf. *Donatia* (*Tricolporites* sp.); l. cf. *Anopterus* (*Tricolporites* sp.)

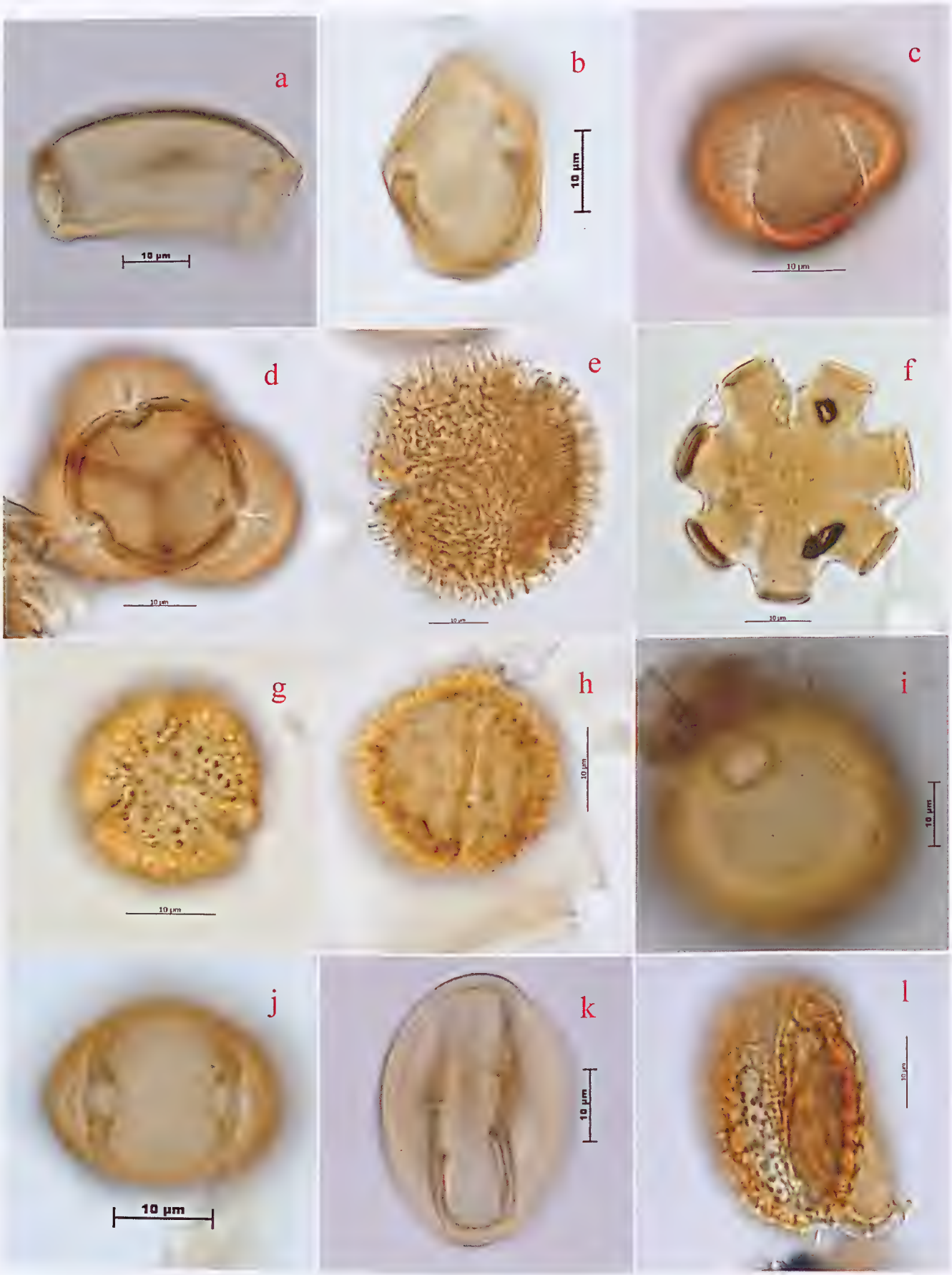

PLATE 5 — Other distinctive pollen morphotypes recorded in Units A & B. Equivalent fossil morphospecies in parentheses. a. *Banksia* sp. [*Banksieaeidites* cf. *Banksia serrata* (Unit B Sample 2)]. b. *Dodonaea triquetra*-type [*Nuxpollenites* sp. (Unit A)]; c. *Haloragodendron*-type [*Stephanocolpites oblatus* (Unit B Sample 2)]; d. Ericaceae [*Ericipites* sp. (Unit A)]; e. Rubiaceae [*Canthiumidites* sp. (Unit A)]; f. Unidentified taxon [*Polycolpites* sp. (Unit A)] g-h. Unidentified taxon [*Spinitricolporites* (al. *Tensucolpites*) sp. (Unit A)]; i. Unidentified taxon [*Triorites* cf. *orbiculatus* (Unit A)]; j. Unidentified taxon cf. *Dysoxylum* [*Tetracolporites* sp. (Unit A)]; k. Unidentified taxon [cf. *Poluspissusites* sp. (Unit A)]; l. Unidentified taxon [*Rhoipites* sp. (Unit B Sample 2)]

AMS radiocarbon age control

Fossil wood from Unit B was submitted for AMS-dating (table 2) but proved to be older than the background radiocarbon limit of c. 45 ka. This confirms the colluvium predates the Last Glacial Maximum at c. 22 ka but by how much geologic time is unknown.

Palynostratigraphic age control

The stratigraphic distribution and estimated relative abundance of all formally-described fossil spores and pollen (miospores) in Samples 1–3 are given in table 1. For comparison purposes, this table includes palynostratigraphic data from an independently dated earliest Miocene deposit that, like the Hannant Inlet site, was located relatively close to palaeocoastline at Fossil Bluff, Wynyard on the North-West Coast of Tasmania (Macphail 1996). Age limits inferred in this paper necessarily assume that morphospecies time-distributions in southernmost Tasmania during the Paleogene-Neogene are comparable with time distributions in the Gippsland and Bass Basins in Bass Strait, and for this reason are expressed as Zone Equivalents (cf. Macphail 1999, Macphail *et al.* 2014).

Basal sandy clay (Unit A)

The age limits of Sample 1 collected from within the basal clay unit is Early to Late Oligocene *Proteacidites tuberculatus* Zone Equivalent, based on (i) *Cyatheacidites annulatus* (NLR *Lophosoria*), a spore whose first appearance datum [FAD] defines the lower boundary of the Early Oligocene to late Early Miocene *Proteacidites tuberculatus* Zone and (ii) *Proteacidites stipplatus*, a distinctive morphospecies which last appears [LAD] in the Late Oligocene *Ophioglossisporites lacunosus* Subzone of the *Proteacidites tuberculatus* Zone (pl. 3a-e). The assemblage includes *Granodiporites nebulosus* (NLR *Embothrium*), a morphospecies that last appears in the Early Oligocene *Granodiporites nebulosus* Subzone of the *Proteacidites tuberculatus* Zone in the Gippsland Basin but which is found in earliest Miocene sediments at Fossil Bluff (cf. Quilty 1972, Macphail 1996). Other species which first or last appear in the *Proteacidites tuberculatus* Zone in southeast Australia include *Nuxpollenites* sp. (*Dodonaea triquetra*-type) and *Foveosporites palaequetrus* (*Lycopodium*), and *Aglaoreidia qualumis* (Typhaceae?), respectively. Several of the more frequently recorded *Nothofagus* and Podocarpaceae morphospecies potentially were canopy dominants in the Oligocene vegetation (pl. 3f–k).

Gravelly clay "colluvium" (Unit B)

The stratigraphically lower of the two samples (Sample 2) representing this unit was collected from within the "turbated" interval at the base of Unit B. The "mixed age" microflora included many of the age-diagnostic morphospecies present in Unit A, e.g., *Granodiporites nebulosus* and *Proteacidites stipplatus*, as well as morphospecies that first appear in the Late Miocene *Foraminisporis bifurcatus* Zone in the Gippsland Basin, e.g., *Monotocidites galeatus* (*Monotoca*). The former morphospecies have been reworked or turbated from Unit A facies, either at the site or from upslope if Unit A extends inland under the "colluvial" deposits. The minimum age is uncertain but will pre-date the Last Glacial Maximum at c. 22 ka given that the NLRs of one morphotype present in the Sample 2, *Nuxpollenites* sp., are extinct in Tasmania (cf. Macphail 1996).

The higher of the two samples (Sample 3) was taken from the clay matrix surrounding a piece of fossil wood mid-section within the unit. This clay yielded a typical Late Quaternary cool-cold climate microflora (cf. Colhoun & van der Geer 1988, 1998), co-dominated by ferns and herbs, in particular Gleicheniaceae (fossil equivalent *Gleicheniidites*) and Centrolepidaceae-Restionaceae (*Milfordia hypolaenoides*), but also includes frequent-to-common *Pherosphaera hookeriana*-type (*Podosporites erugatus*) and *Lagarostrobos franklinii* (*Phyllocladidites mawsonii*) pollen. Although these taxa and many other morphospecies in the sample have Paleogene FADs, at least one taxon, *Tubulifloridites pleistocenicus* (*Cassinia arcuata*-type), first becomes consistently recorded in the Early Quaternary in southeastern Australia. Two rare taxa in the microflora, *Leucopogon* (Epacridaceae) and *Pomaderris apetala*-type (Rhamnaceae) have not been recorded in sediments older than Middle-Late Pleistocene in Tasmania, whilst the absence of *Symplocos* (*Symplocoipollenites austellus*) is negative evidence that the sample is younger than Middle Pleistocene (cf. Macphail *et al.* 1993b, Augustinus & Macphail 1997). For these reasons and radiocarbon dates exceeding 45 ka (table 1), we infer the mid-upper section

TABLE 2 — Radiocarbon dates for wood samples from Unit B (from Bowman *et al.* 2013).

Lab. code	Sample ID	$\delta^{13}C$ ‰	ρMC[1]		^{14}C ages (BP)
			Mean	1δ	Mean
OZN107[2]	Hannant Inlet Sample 1	–20.4	0.00	0.03	NDFB[3]
OZN108[2]	Hannant Inlet Sample 1	–20.6	0.00	0.03	NDFB[3]

[1] ρMC percent modern carbon.
[2] Extracted alpha-cellulose was used for dating.
[3] NDFB: Not distinguishable from background.

of Unit B is early Late Pleistocene in age. It is possible that the unit is a correlative of the Cox Bight sub-fossil wood deposit, which overlies a poorly sorted sub-round quartzite cobble and gravel deposit (cf. Bowman *et al.* 2013).

Quartzite gravels (Unit C).
This >10 m thick unit of "clean" angular quartzite fragments lacked visible organic inclusions and was not sampled for this study. The lithology is inconsistent with Unit C being a raised beach deposit (cf. Williams 1982) and, although typed as "colluvium" (this study), the unit, like Unit B, may be alluvium deposited in a high-energy fluvial environment. Whether the clasts are the result of frost-shattering on a quartzite outcrop upslope during the Last Glacial Maximum is uncertain (cf. Colhoun 1977) although both inferences seem likely.

Depositional environments

Colonies of the green alga *Botryococcus* and *Stereisporites* (*Sphagnum*) spores indicate Unit A accumulated in a fen or cut-off channel on the eastern side of the Hannant Inlet palaeovalley during the Oligocene. High relative pollen abundances of the extinct shrub conifer *Podosporites microsaccatus* are consistent with this depositional environment (cf. Tulip *et al.* 1982). In contrast, Unit B was deposited within a Gleicheniaceae-Restionaceae (or Centrolepidaceae) mire fringed by *Pherosphera hookeriana* and Casuarinaceae, or the sample (Sample 3) incorporates sediment that had accumulated in such an environment during the Late Pleistocene. *Gleichenia*-Restionaceae-dominated "bog" communities are widespread across a range of elevations in South-West Tasmania and one Casuarinaceae species in Tasmania, *Allocasuarina monilifera* (L.A.S. Johnson) L.A.S. Johnson, extends from near sea-level up to c. 1100 m elevation. However, few, if any, modern cold-climate mires in Tasmania are surrounded by both *Allocasuarina/Casuarina* and *Pherosphaera hookeriana*. The combined data point to Unit B being deposited during a cold interval in the Last Glacial Stage than an earlier glaciation.

Relationship to past sea levels

Agreement exists that global sea levels were significantly below the present-day level during the earliest Oligocene and significantly higher than at present during the Early Miocene (see Haq *et al.* 1987, Miller *et al.* 1996, Houben *et al.* 2012, Lewis & Quilty 2009, Quilty 2014) although actual elevations are difficult to estimate for a given location. For example, Quilty & Seymour (2010) note there is a difference of about 1 km between Early Miocene shallow marine sediments at 160 m elevation inland of Temma on the North-West Coast and correlatives at 800 m water depth south of Tasmania and suggest this involves tilting of the island as well as changes in relative sea level. The same *caveat* applies to the Late Cenozoic where glacio-eustatic-forced changes in relative sea level are blurred by uplift and tilting (Houshold *et al.* 2006, Colhoun *et al.* 2014). All that can be inferred with moderate confidence is that (a) the absence of marine dinoflagellates and other saline indicators imply Unit A was deposited in a non-marine environment, even if Hannant Inlet was open to the Southern Ocean at this time, and (b) cold conditions during the deposition of Unit B is circumstantial evidence that site could have been up to 100–150 m above sea level, and 7–15 km inland from the palaeo-coastline during a cold stage within the last or a preceding Pleistocene glaciation (Colhoun *et al.* 2014). The same constraints apply to the sequence incorporating the sub-fossil logs at Cox Bight.

Palaeovegetation and climate

All fossil pollen and spore assemblages are a partial record of past floras, with some indication of the relative abundance of the parent plants in the source vegetation. The latter values are strongly biased by the intrinsic pollen production and dispersal characteristics of the plants (Representivity) as well as by depositional environment, which influences the extent to which miospores derived from the regional vegetation are "diluted" by the influx of miospores from plants growing on, around or (fluvio-deltaic contexts) upstream of a site (see Macphail 2007).

These *caveats* aside, significant to high relative abundances of Araucariaceae, Podocarpaceae, *Nothofagus* and Casuarinaceae (*Gymnostoma*?) pollen confirm the dryland vegetation growing on the eastern side of Hannant Inlet during the Oligocene almost certainly was one of numerous variants of the *Nothofagus*-gymnosperm evergreen temperate rainforest established across Tasmania and southern Australia in general throughout the Late Paleogene (see Macphail *et al.* 1994, 2014). No modern analogues of this warm temperate rainforest community exist, either because the taxa are extinct in Australia, or because their NLRs have contracted to a small part of their Cenozoic geographic range. For example (NLRs in parentheses), at least six woody taxa are restricted to humid, mesotherm to megatherm climates, viz. *Beaupreaidites elegansiformis* and *B. verrucosus* (*Beauprea*), *Bluffopollis scabratus* (Strasburgeriaceae), *Cupanieidites orthoteichus* (Cupanieae), the complex of *Nothofagidites emarcidus* morphotypes [*Nothofagus* (*Brassospora*) spp.], *Quintiniapollis psilatispora* (*Quintinia*) and *Sapotaceoidaepollenites rotundus* (Sapotaceae). In contrast, the taxa likely to have formed a gymnosperm overstorey mostly have NLRs that are confined to cooler (lower mesotherm-microtherm) environments. Examples are *Dacrycarpites australiensis* (*Dacrycarpus*), *Dacrydiumites florinii* (*Dacrydium*), *Microalatidites palaeogenicus* (*Phyllocladus*), *Microcachryidites antarcticus* (*Microcachrys*) and *Phyllocladidites mawsonii* (*Lagarostrobos*). Several of these taxa were extirpated from Australia as recently as the Late Pliocene (*Nothofagus* (*Brassospora*) spp.) or Pleistocene (*Dacrycarpus, Dacrydium*). Three other clades now are endemic to South America, viz. *Cyatheacidites annulatus* (*Lophosoria*), *Granodiporites nebulosus* (*Embothrium*) and *Nothofagidites flemingii* [*Nothofagus* (*Nothofagus*) spp.]. The Asteraceae species represented by *Tubulifloridites pleistocenicus* is likely to have been extirpated from Tasmania by the early Holocene. One probable shrub gymnosperm,

Podosporites microsaccatus (*Microcachrys*?), is wholly extinct. Several of the pollen morphotypes have not been recorded previously and/or have no known NLR (pl. 5).

Based on the present-day ecological amplitude of *Nothofagus* (*Brassospora*) spp. in New Caledonia and New Guinea (Table 7.4 in Read & Hope 1996), it is probable that precipitation was more than 2000 mm pa, and the climate lacked a dry season. For the same reason, mean annual temperatures are estimated to have been at the lower end of the 12–24°C (mesotherm) range. Differences in the composition of the rainforest at Hannant Inlet and Fossil Bluff are minor (table 1). For example, only five morphospecies whose Australian NLRs are considered typical of warm to hot (mesotherm-megatherm) environments occur at Fossil Bluff but not at Hannant Inlet, viz. *Clavatipollenites glarius* (*Ascarina*), *Ilexpollenites anguloclavatus* (*Ilex*), *Myrtaceidites verrucosus* (*Austromyrtus*-type), *Psiladiporites* (*Alyxia*) and *Tricolporopollenites endobalteus* (*Macaranga-Mallotus*). Accordingly, the data imply climatic gradients within Tasmania were subdued relative to the present, but, the variations that are observed can equally well be explained by the northward drift of the Australian continent from c. 63°S–58°S during the Oligocene to Early Miocene (see Veevers *et al.* 1991).

The microflora recovered from the "turbated" zone at the base of Unit B (Sample 2) is unreliable evidence for the nature of the Late Pleistocene vegetation although the data confirm that *Eucalyptus* spp. were very rare and *Pherosphaera* relatively common in the local vegetation during the period of deposition (cf. Macphail 1979). Reconstruction of the community recorded in Sample 3 is less complicated since the parent plants either grow in the Port Davey area or conceivably could have done so in the geologically recent past. For example, the association of *Pherosphaera*, Gleicheniaceae, Restionaceae, Epacridaceae, *Microcachrys* and Apiaceae is typical of bog and herbfield communities in the upper subalpine-alpine zone on many higher mountains in South-West Tasmania. Moderately high relative abundances of *Pherosphaera* pollen (15%) are evidence either *Pherosphaera hookeriana* or a close relative of this cold climate shrub conifer was growing on the site, now some 1000 m below its present-day lower altitudinal limit on Mt Field (see Macphail 1979). Sclerophyll shrubs or small trees including *Allocasuarina/Casuarina* are likely to have occupied much the same freely-draining sites as at present although the shrub flora included genera that are unlikely to be found in coastal buttongrass moorland at present, e.g., *Ricinocarpos* and a pollen morphotype (pl. 5a) that resembles pollen of *Banksia serrata* L.f., now confined in Tasmania to relict stands around Sisters Beach on the North-West Coast and Flinders Island. Assuming *Pherosphaera*, Apiaceae and *Nothofagus* (*Fuscospora*) pollen represent *Pherosphaera hookeriana*, *Dichosciadium ranunculaceum* (F.Muell.) Domin and *Nothofagus gunnii* (Hook.f.) Oerst respectively, mean temperatures were c. 4°C and potentially up to 7–8°C below present (cf. Colhoun & van der Geer 1987, 1998, Colhoun *et al.* 2014).

We emphasise the Late Pleistocene parent plants may include now-extinct clades and that some Tasmanian cold-climate taxa occurred well beyond their modern climatic range in Australia and elsewhere in the Pleistocene. This concept is supported, for example, by the association of macrofossils of the (now) upper subalpine-alpine zone mat conifer *Microcachrys* and the warm temperate genus *Austromyrtus* in Early to Middle Pleistocene deposits at Regatta Point, Strahan on the West Coast of Tasmania (Jordan *et al.* 1995, Macphail & Hill 1995). For the same reason, we are unable to preclude the possibility that a lowland/cool-climate ecotype of *Pherosphaera hookeriana* was present in Tasmania during the earlier Pleistocene although no macrofossil evidence for this has been found to date. Despite this uncertainty, we conclude that the annual and seasonal rainfall at the time when Unit B was deposited was adequate to support a heterogeneous association of cool-cold temperate rainforest and rainforest scrub species including *Nothofagus cunninghamii*, and *Phyllocladus*, and sclerophyll taxa (pls 4, 5), but not rainforest *per se*, somewhere in the mountainous hinterland and/or on the coastal plain around Hannant Inlet.

DISCUSSION

The three microfloras preserved at Hannant Inlet are genetically linked in that these reflect different stages in the impact of Late Cenozoic global cooling (see fig. 2 in Zachos *et al.* 2008) on the Tasmanian flora and vegetation, a development that is "book-ended" by transient montane glaciation in northern Tasmania during the Early Oligocene (Macphail *et al.* 1993a) and periglacial and (mountain ranges) glacial environments across southern Tasmania during the Quaternary (see Colhoun *et al.* 2104). Notwithstanding the c. 23 million-year gap in the geologic record between Samples 1 and 3, the Hannant Inlet sequence is strategically sited to explore (a) phytogeographic links at high palaeolatitudes across the Southern Hemisphere and (b) climate-forced changes in coastal/lowland floras in South-West Tasmania preceding the Last Glacial Maximum at c. 22 ka.

Phytogeographic links between South-West Tasmania, Antarctica and southern South America during the Late Paleogene

The Oligocene microflora at Hannant Inlet postdates the submergence of the South Tasman Rise "landbridge" to Antarctica and onset of major ice-sheet glaciation in Antarctica during the Late Paleogene (see Exon *et al.* 2004, Truswell & Macphail 2008). Although palynological dominants (and presumed canopy dominants) such as Araucariaceae, Podocarpaceae and Nothofagaceae, are common to East Antarctica, the South Tasman Rise, and Tasmania, this in likely to be an artefact of broad morphospecies definitions, i.e., the pollen types may represent different species or ecotypes. The same relationship is not reflected in the presumed subcanopy flora. For example, a number of the minor taxa recorded in East Antarctica and western Tasmania are common to both regions only during the Early Eocene when sea surface temperatures in Macquarie

Harbour were at near tropical values (Pole & Macphail 1996, Truswell 1997, Macphail 2002, 2007, Truswell & Macphail 2008, Carpenter *et al.* 2012). Examples (NLRs in parentheses) are *Polypodiaceoisporites* (*Pteris*), *Anacolosidites* spp. (*Anacolosa*), *Myrtaceidites tenuis* (*Eucalyptus sensu lato*) and *Intratriporopollenites notabilis* (Tiliaceae).

This is not unexpected since most of these taxa are thermophiles that became extinct during the Middle Eocene, but a larger group of thermophiles found in Tasmania (and elsewhere across southern Australia) are recorded only as far south as the South Tasman Rise. Examples are *Kuylisporites waterbolkii* (*Hemitelia*), *Verrucosisporites kopukuensis* (*Lygodium*), *Spinizonocolpites prominatus* (*Nypa*), *Beaupreaidites* spp. (*Beauprea*) *Cupanieidites orthoteichus* (Sapindaceae tribe Cupanieae), *Santalumidites cainozoicus* (Santalaceae), *Sapotaceoidaepollenites* spp. (Santalaceae) and *Bluffopollis scabratus* (Strasburgeriaceae). A plausible corollary is that by the Middle-Late Eocene, the canopy as well as subcanopy floras had undergone significant adaptive radiation to local conditions and morphogenera apparently shared between southeastern mainland Australia (including Tasmania), Antarctica and South America represent different species or genera, as has been confirmed for the araucarian clade *Dilwynites* (*Agathis/Wollemia*) (Macphail *et al.* 2013). Contrary to expectation, e.g., Corbett (2014), the onset of cooler climates during the Eocene-Oligocene transition appears to have restricted the migration of cool-cold adapted species between Antarctica and Tasmania since two only morphospecies that evolved/migrated during this period can be confirmed to have appeared earlier in East Antarctica than in Tasmania. These are a Droseraceae (*Fischeripollis* sp.) whose closest NLR is the Venus-Flytrap genus *Dionea* now endemic to southern USA, and the extinct clade represented by *Periporopollenites hexaporus*. Significantly, specimens on both landmasses occur in glacial contexts (Macphail *et al.* 1993a, Macphail & Hill 1994, Truswell & Macphail 2008).

On the balance of probabilities, we conclude the majority of shared taxa migrated from Australia *southwards* onto the South Tasman Rise, and for the same reason, speculate that the reverse pathway, from East Antarctica to Tasmania via the South Tasman Rise, played only a minor role even during the benign conditions that characterised the Early Eocene hyperthermals (see Zachos *et al.* 2008). A reduced role for Antarctica in Cenozoic plant migration strengthens the case for trans-oceanic dispersal of plants across the palaeo-Pacific Ocean between Australia and southern South America. For example, at least three taxa found in the Early Oligocene glacigene sediments in Tasmania (two occur at Hannant Inlet) are not recorded in East Antarctica during the Late Eocene but are present in the Eocene-Oligocene in South America, viz. *Lophosoria*, *Embothrium* and Asteraceae tribe Mutisieae (fossil equivalent *Mutisiapollis patersonii*). In the case of *Lophosoria*, trans-oceanic dispersal between Australia and South America is strongly supported by the establishment of this groundfern on the Kergulen Islands in the remote southern Indian Ocean in the Miocene, as well as by occurrence of macrofossils of the sole extant South American species *Lophosoria quadrapinnata* (J.F.Gmelin) C.Chr. in an Oligo-Miocene deposit at Balfour on the West Coast of Tasmania (Cookson 1947, Hill *et al.* 2001). Plant migration across the Pacific Ocean seems to have occurred in both directions since the earliest records of *Lophosoria* and Mutisieae occur in South America (Eocene) whilst *Embothrium* occur earlier in southeast Australia (Barreda *et al.*, 2012, M. Quattrochio pers. comm. 2013).

Early Late Pleistocene

By the time Unit B was deposited in Hannant Inlet, the Tasmanian flora had been subjected to Quaternary "glacial winnowing" for up to 2.4 Ma (see Macphail *et al.* 1993b, 1995). In this instance, the common occurrence of *Pherosphaera* and other cold-climate taxa at low elevations was expected because of (1) the inferred age of Unit B and (2) other fossil records of these taxa at low elevations during the Last and earlier Glacial Stages. For example, relict populations, macrofossils and/or pollen of *Pherosphera hookeriana* and other cold-climate taxa such as a plum pine, *Podocarpus lawrencii* Hook.f., the bolster-plant *Donatia novae-zelandiae* Hook.f. have been recorded at relatively low elevations in Tasmania, e.g., along the Douglas River on the East Coast, and in Penultimate Glacial Stage glacio-lacustrine clays underlying till near Rosebery (162 m elevation), in Middle-Late Quaternary lacustrine sediments infilling the Darwin Meteor Crater (180–120 m elevation) near the Andrew River and in the King River Valley (c. 160 m elevation) in western Tasmania (Macphail & Moscal 1981, Colhoun & van der Geer 1987, 1988, 1998, Gibson *et al.* 1987). With the apparent exception of the creeping pine, *Microcachrys tetragona* (Hook.f.) Hook.f., few modern cold-climate taxa in Tasmania are strictly "alpine" in that their populations now are confined to elevations above the climatic treeline. Nevertheless, as far as we are aware, the Hannant Inlet and Cox Bight sites are unique in preserving evidence that the *Pherosphaera hookeriana* actually grew close to the present-day coastline during the Late Pleistocene (cf. Bowman *et al.* 2013).

The extended range contrasts with the current distribution of *Pherosphaera hookeriana*. This shrub gymnosperm, together with the tree-fern *Cyathea* (Cyatheaceae) and at least two herbs, *Gunnera* (Gunneraceae) and *Haloragodendron*-type (Haloragaceae), form a small group of higher plants in Tasmania that have failed to recapture their pre-Last Glacial Maximum distribution (Colhoun 1980, M.K. Macphail unpubl. data). The reasons for this are unclear, especially since pollen data confirm that *Pherosphera*, as well as other cold-climate taxa *not* recorded at Hannant Inlet during the Late Pleistocene (*Microcachrys*, *Astelia*), had survived through several stadial/interstadial cycles at the low elevation Darwin Crater site. One possibility, which is supported by the delayed (late early Holocene) establishment of *Pherosphaera* in the subalpine zone on Mount Field (Macphail 1979), is its low vagility and competitive ability were inadequate to cope with rapid rises in mean air temperatures during the deglacial period and earlier Holocene period. However, this does not resolve the related question why other ecologically disparate taxa in the same

group exhibited the same major contraction in range. An alternative working hypothesis is that the phenomenon is the result of the geologically recent extinction of unrecognised ecotypes as has been demonstrated for the genus *Banksia* (Jordan & Hill 1991).

CONCLUSIONS

The Hannant Inlet microfloras are a significant geographic extension to what already has been recorded about the Cenozoic floras in Tasmania (Hill *et al.* 1999, Macphail *et al.* 2014). For example, fossil pollen of the subgenus (*Lophozonia*) of *Nothofagus* that includes *N. cunninghamii*, the modern dominant of cool temperate rainforest in Tasmania, are present in low but significant numbers (3–4%) in Oligo-Miocene sequences at the Hannant Inlet and Fossil Bluff. However, the associate species differ markedly from those in extant cool temperate rainforest in Tasmania and the fossil record at Hannant Inlet is strongly against such forests being the lineal descendants of rainforests that occupied eastern Gondwana prior to its breakup in the Late Mesozoic-Early Paleogene (compare http://tarkine.org/rainforest/2014). Nevertheless, the wet-forest *flora* in South-West Tasmania is an ancient one, except at the species level, and extant families and some of the more prominent genera have been shared between Australia, Antarctica, New Zealand and southern South America for all or part of the Cenozoic. A surprising example is the eucalyptoid clade represented by *Myrtaceidites tenuis*, which occurs in Early Eocene deposits in Antarctica and southern South America as well as central and southern Australia, including Tasmania (Macphail *et al.* 1994, Hermsen *et al.* 2012, Thornhill & Macphail 2012, Contrares *et al.* 2013, M.K. Macphail unpubl. data). The combined database confirms our belief that Tasmania preserves arguably the most geographically concentrated and often best-preserved natural archive in Australia of plant macrofossils and microfossils covering the last 65 million years (Cenozoic), as well as the only archive that covers the full altitudinal spectrum of environments over the Late Paleogene and Early Neogene (see Macphail 1987, Hill *et al.* 1999, Colhoun *et al.* 2014, Forsyth *et al.* 2014, Macphail *et al.* 2014). As for Hannant Inlet, the exploration of this "archive" is often dependent on chance discoveries. Any actions designed to promote the study of the geoheritage of this remote region can only be helpful in reconnecting Tasmania to its Gondwanan past.

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SHACKLETON'S ENDURING LEGACY

by Christine Hurley

(with one plate)

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Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 129, Hobart, Tasmania 7001, Australia. Email: churley@utas.edu.au

Sir Ernest Shackleton's name is one forever associated with the Antarctic Heroic Era (1895–1922), the latter year being that of his death. Shackleton was an intrepid explorer, voyaging to Antarctica four times and is often compared to contemporary explorers Roald Amundsen, Douglas Mawson and Robert Falcon Scott. Shackleton's achievements are a result of a combination of natural leadership and finely-tuned management skills, assisted by a strong element of luck. This paper explores Shackleton's enduring legacy through the contemporary lens of scientific discovery and exploration, modern leadership training methods and management techniques, and observations of his influence upon Antarctic tourism, particularly "adventure" tourism.

Key Words: Shackleton, H.M.S. *Discovery*, H.M.S. *Endurance*, H.M.S. *Nimrod*, H.M.S. *Quest*, Antarctic expeditions

INTRODUCTION

Centennial celebrations of the Heroic Era of Antarctic expeditions (exemplified by explorers Scott, Amundsen, Mawson and Shackleton) have taken place over recent years and the centenary of Shackleton's Imperial Trans-Antarctic (H.M.S. *Endurance*) expedition (1914–1917) is currently being celebrated. Ernest Shackleton is widely recognised as a major figure of the Heroic Era. He was of Irish birth and had gained his extensive sea-going experience through a lengthy period of service in the British Merchant Navy as opposed to the Royal Navy, which historically attracted a different class of person in what was then an extremely class-conscious society in Britain. He participated in Robert Falcon Scott's National Antarctic (H.M.S. *Discovery*) expedition (1901–1904) and in the three-man party, led by Scott and accompanied by Edward Wilson, which attempted (unsuccessfully) to reach the South Pole. During his own British Antarctic (H.M.S. *Nimrod*) expedition (1907–1909) he led the Southern Party when, together with Adams, Marshall and Wild, he reached 82°S, "furthest South".

Later, following the H.M.S. *Endurance* expedition, reports of Shackleton's success in ensuring the survival of all of his men and their subsequent rescue from Elephant Island more than eclipsed his failure to achieve his intended crossing of the Antarctic continent from the Weddell Sea to the Ross Sea. Despite Shackleton's death on South Georgia during the H.M.S. *Quest* expedition (1921–1922), the scientific achievements of that expedition (published by the American Geographical Society in 1931) were considerable (Campbell Smith 1931).

This paper analyses Shackleton's enduring legacy with particular reference to his personal attributes, which both during his lifetime and in subsequent decades have become legendary, and will include a summary of his explorations. His legacy is of wide-ranging significance, encompassing early exploration and research extending to present-day training in leadership skills, contemporary management techniques and Antarctic tourism. Roald Amundsen was quoted as saying that "Sir Ernest Shackleton's name will for evermore be engraved with letters of fire in the history of Antarctic exploration" (Huntford 1985, frontispiece). Raymond Priestley, geologist (later Sir Raymond) elaborated "For scientific leadership, give me Scott; for swift and efficient travel, Amundsen, but when you are in a hopeless situation, when there seems to be no way out, get down on your knees and pray for Shackleton" (Lansing 1961, p. 24). The majority of men who served with Shackleton, together with his family and friends, all acknowledged his particular brand of loyalty, affection, camaraderie and sense of responsibility so often extended on their behalf and for their benefit.

SCIENTIFIC DISCOVERY AND EXPLORATION: H.M.S. *DISCOVERY*, H.M.S. *NIMROD*, H.M.S. *ENDURANCE* AND H.M.S. *QUEST* EXPEDITIONS

As well as being leader of the H.M.S. *Discovery* expedition (1901–1904) in which Shackleton served as third officer, Commander Robert Falcon Scott R.N. was also director of scientific staff (Fiennes 2003). Shackleton did not have direct responsibility, therefore, for the many scientific achievements of that expedition. However, the importance of scientific discovery and exploration to that expedition, and subsequently to that of the H.M.S. *Terra Nova* (1910–1913), which resulted in members of Scott's small ill-fated party continuing to man-haul 35 pounds (16 kg) of rock samples on their debilitating return journey from the South Pole, would not have been lost on Shackleton.

While geographical discovery and exploration continued to be Shackleton's priorities, scientific achievements of the H.M.S. *Nimrod* expedition included many other important "firsts". Expedition members were the first to climb Mount Erebus on Ross Island, first to reach the vicinity of the South Magnetic Pole and first to pioneer the original route to the Geographic South Pole (Riffenburgh 2004). Shackleton

reported the scientific results of the expedition in detail to the Royal Geographical Society upon his return to London, but before he could do so they were summarised by the Wellington, New Zealand, correspondent of *The Times* newspaper, who cabled them to *The Times*' London office. The *Times*' report included reference to:

- frozen glacier-eroded lakes near Cape Royds abounding in diatoms, rotifers, water bears and infusoria;
- melting of snow at temperatures below zero and at a height of 9,000 feet on the black lava rocks of Mount Erebus;
- marine fauna near Cape Royds bearing a resemblance to the types of animal life of the coal measure series found in Australia and Tasmania;
- masses of marine muds containing vast numbers of foraminiferal shells 40 feet above the sea level, found by the northern expedition;
- the summit crater of Mount Erebus being very active as regards steam and sulphur gases;
- coal measures discovered far south were probably older than the Tertiary Period; and the fact that
- geological discoveries made by the expedition disproved the Antarctic archipelago theory (Shackleton 1909a, b).

Both the H.M.S. *Discovery* and H.M.S. *Nimrod* expeditions made small but important contributions to the subsequent establishment of a research station on Macquarie Island, situated to the south of Tasmania which would become an important link in the establishment of radio contact between Antarctica and the rest of the world (Fitzsimons 2011). A party from H.M.S. *Discovery* spent an afternoon at the island in November 1901, reporting on the penguins, kelp and tussock grass, and John King Davis, when captaining H.M.S. *Nimrod*, briefly landed a party on the island which collected some specimens (Day 2007). In an address to the Royal Geographical Society on 10 April 1911, Douglas (later Sir Douglas) Mawson discussed the proposed establishment of a base at Macquarie Island, whereby "a party of five men would be left to conduct meteorological, biological and geological studies, while also setting up wireless antennae that, ideally, will allow their Antarctic base to reach them and allow them to communicate with the Australian mainland" (Fitzsimons 2011, p. 290).

When planning for the H.M.S. *Endurance* expedition in 1914, Shackleton prepared written statements for the Royal Geographical Society's journal on more than one occasion, outlining his proposed schedule, detailing the scientific research to be undertaken but specifically referring to the crossing of the Antarctic continent as his primary objective (Shackleton 1914a). The H.M.S. *Endurance* spent a month at South Georgia at the end of 1914 before departing for the Antarctic. Responding to a request from the whaling station at Grytviken, Shackleton was instrumental in providing navigational assistance to the whalers (Burton 2010). Shackleton, writing to Reginald Perris on 30 November 1914, noted that the most important work done during his visit had been the erection of the set of true meridian posts, enabling 21 whalers and other steamers to correct their compasses, something urgently required according to the Admiralty's stated objectives (Shackleton 1914b). Shackleton's subsequent H.M.S. *Quest* expedition achieved considerable success in its scientific research, with geological and petrological discoveries exceeding the physiographical aspects (Campbell Smith 1931).

Early exploration of Antarctica and scientific research conducted during successive expeditions resulted in sovereignty claims by nations whose citizens had established earlier footholds on the continent. The claims to the British Antarctic Territory originated many years ago and continue to be regarded as extremely important. Whaling nations are known to have paid licence fees to Britain to fish in the British territory before commencement of the Heroic Era (P.G. Quilty pers. comm.). Shackleton's legacy to scientific discovery and exploration included his mentoring of geologist Douglas Mawson both through his appointment as physicist aboard H.M.S. *Nimrod* and in the setting up of Mawson's own Australasian Antarctic Expedition (1911–1914) (Lucas 2012). Shackleton could not, however, have envisaged that it would be Mawson who later would make the case for Great Britain's claim to sovereignty in the Antarctic or that the benefits of this claim would subsequently be transferred to Australia. "On 13 January 1930 Sir Douglas Mawson read the following proclamation while the Union Jack was raised on what was named Proclamation Island off Enderby Land: 'In the name of His Majesty King George the Fifth, King of Great Britain, Ireland, the British Dominions beyond the Seas … I have it in command from His Majesty King George the Fifth to assert the sovereign rights of His Majesty over British Land discoveries met with in Antarctica …' " (Rowe 2002, p. 8). Mawson later repeated a recitation of the proclamation while in the cockpit of a Gypsy Moth biplane piloted by Stuart Campbell flying over the Antarctic continent, with Campbell throwing a weighted Union Jack onto the ice (Rowe 2002).

While Mawson undoubtedly "stands alone in terms of influence on Australian interests in the Antarctic" (Haward 2007, p. 23), Shackleton's participation in the four highly publicised British expeditions, H.M.S. *Discovery*, H.M.S. *Nimrod*, H.M.S. *Endurance* and H.M.S. *Quest*, strengthened the case for Mawson to promote Great Britain's claim to sovereignty over the "Australian Quadrant" in the Antarctic. The subsequent establishment of the Australian Antarctic Territory in 1936 may be said to represent the most important aspect of Shackleton's enduring legacy. His persistence and determination in doggedly continuing to represent British (and thereby, indirectly, Australian) interests in the Antarctic underpinned Great Britain's subsequent claims to sovereignty. The administration of what became the Australian Antarctic Territory was transferred to Australia from the United Kingdom in 1933, following a claim made to the territory for Britain and King George V by Douglas Mawson as part of the British, Australian and New Zealand Antarctic Research Expedition (BANZARE) in 1929–31 (Kriwoken *et al.* 2007).

This in turn facilitated the establishment and development of Australia's three scientific bases, Casey, Davis and Mawson stations, and ensured Australian participation in ongoing scientific research on the Antarctic continent for peaceful purposes under the terms of the Antarctic Treaty 1961.

"Australia's intent has clearly been to create a legal regime that reflects Australian sovereignty over Antarctica and also a national policy of promoting the freedom of scientific research and environmental protection" (Kriwoken *et al.* 2007, p. 12).

Shackleton was in the audience when Mawson presented a lecture to the Royal Geographical Society on his return to London, and was invited to extend the vote of thanks to the speaker. In doing so, he enthused: "It was of great interest to me that Mawson and Davis, who for the first time went south on our last expedition, should have made one of the best expeditions ever carried out in the Antarctic" (Shackleton & Curzon 1914, p. 286). Apsley Cherry-Garrard, assistant biologist on the H.M.S. *Terra Nova*, sums up the relevance of exploration to scientific achievement very succinctly, stating simply that "Exploration is the physical expression of the Intellectual Passion" (Quigg 1983, p. 5).

LEADERSHIP

The regard and respect in which Shackleton was held, particular by the men under his command, is possibly only equalled by the regard and respect which he accorded others. "The mystique that Shackleton acquired as a leader may partly be attributed to the fact that he elicited from his men strength and endurance they had never imagined they possessed; he ennobled them" (Alexander 1998, p. 194). Cherry-Garrard records "There are jobs for which, if I had to do them, I would like to serve under Scott, Amundsen, Shackleton and Wilson – each to his part. For a joint scientific and geographical piece of organisation, give me Scott; for a Winter Journey, Wilson; for a dash to the Pole and nothing else, Amundsen: and if I am in the devil of a hole and want to get out of it, give me Shackleton every time. They will all go down in polar history as leaders, these men" (Cherry-Garrard 1922, Vol. 1, preface).

Frank Worsley, merchant officer aboard H.M.S. *Nimrod* and captain of H.M.S *Endurance,* wrote " Shackleton's popularity among those he led was due to the fact that he was not the sort of man who could only do big and spectacular things ... When occasion demanded, he would attend personally to the smallest details ..." (Alexander 1998, pp. 193–4).

Shackleton was well aware of the need to keep his men occupied during the long winter months when daylight disappeared from the Antarctic continent. When serving as third officer on H.M.S. *Discovery* he had been appointed by Scott as editor of *The South Polar Times,* a publication which encouraged a wide-ranging variety of contributions from officers and men alike and which had proved successful in providing an outlet for otherwise unexpressed emotions (Fiennes 2003). When preparing for his own H.M.S. *Nimrod* expedition, Shackleton planned and produced the first book ever published in the Antarctic, *Aurora Australis* (Shackleton 1909c) undeterred by the necessity to transport the expedition's own printing press aboard the ship.

Two weeks after the return of the H.M.S. *Nimrod* expedition, Shackleton attended a meeting of the Royal Geographical Society in the Albert Hall, London, on Monday 28 June 1909, held in honour of himself and his companions. After Shackleton presented a lecture on the achievements of the expedition the President of the Society, Leonard Darwin, commented "the many noble qualities (that) are necessary to make a successful leader of explorations into unknown lands; and the first of these qualities is courage.... Not the least of Mr. Shackleton's merits as a leader was, I believe, the care he took to make the utmost use of the experience he had previously gained when serving on the National Antarctic expedition under Captain Scott..." (Darwin 1909, p. 125).

Later Scott, having been asked to acknowledge Shackleton's achievements, spoke generously, saying that he "regarded it as a great privilege to have been asked to propose this vote of thanks tonight" (Scott 1909, p.126).

Thomas Orde-Lees, motor expert (later store-keeper) aboard H.M.S. *Endurance*, wrote in his journal on 23 December 1914 of Shackleton's efforts "He is indefatigable, up all day and night on the bridge and in the crow's nest and yet always the most cheerful amongst us and finding time for a game of Bridge or Patience, of both of which he is very fond, and also able to spare the time to attend to the hundred and over little details of each of our respective departments....The more I know him the greater becomes my admiration for his ability as a leader. Although he is expert at nothing in particular, he is easily master of everything" (Orde-Lees 1914). Orde-Lees does, however, record in his journal that, by 11 January 1915, he came close to insubordination, a state of affairs which he put down to anxiety and which he later regretted.

Some years later A.W. Greely, following his review of Shackleton's publication *South,* wrote "The narrative is marked by its appreciation of the members of the two expeditions, and from it one is confirmed in the realisation that Shackleton is a leader of men of unusual ability and force. Considerate of his subordinates, he never spared himself, and under a less able leader the Weddell Sea party would have perished" (Greely 1920, p. 546).

Commencing with his earliest expeditions, Shackleton strove to appoint applicants not just for the relevance of their qualifications for a particular post but as individuals who emanated a certain attraction, as in the case of Frank Worsley (Barczewski 2007). Those who were successful in being appointed to a position of responsibility were quite naturally grateful to Shackleton for his vote of confidence and extended their ongoing friendship to him in return. Frank Wild, in particular, became one of Shackleton's closest friends. Wild died in South Africa on 20 August 1939. In acknowledgement of this friendship, when information recently came to hand concerning the whereabouts of Wild's ashes, these were subsequently retrieved some ninety years after the latter's death and placed to the right hand side of Shackleton's grave at Grytviken with the inscription "Frank Wild, 1873–1939, Shackleton's right-hand man" (P.G. Quilty pers. comm.).

In contrast to Shackleton's unfailing support for the majority of his men, he could be totally unforgiving in

circumstances where he considered his authority to be contested and where he saw his men's safety and/or survival put at risk as a result. For these reasons he refused to endorse the award of a Polar Medal to four members of the H.M.S. *Endurance* expedition, including carpenter Harry McNish (incorrectly referred to in some polar literature as McNeish). This is regrettable, since McNish was responsible for reinforcing the three lifeboats, including the *James Caird*, which enabled Shackleton and his men to reach Elephant Island safely (and a small party subsequently to continue to South Georgia) following the loss of H.M.S. *Endurance*. McNish reportedly never forgave Shackleton for ordering that his beloved tomcat, Mrs Chippy, be put down prior to the expedition's trek across the ice in order to protect the animal from the dogs (Alexander 1998).

During the Antarctic Heroic Era, once a ship had sailed from port there was no communication with anyone ashore until its return. Thus the world learned of Amundsen's successful attempt to be first to reach the South Pole only when he arrived back in Tasmania and telegraphed a coded confirmatory message home to Norway from the General Post Office, Hobart. News of the tragic death of Scott's party on its return from the Pole was not known for many months until the expedition's ship H.M.S. *Terra Nova* arrived back in her home port. Officers and crew were therefore dependent upon the skills of their leaders for the duration of a voyage – for good or for bad. For the men of H.M.S. *Endurance*, their dependence upon Shackleton was for the good – his care and concern for his men are documented throughout relevant literature; for example, "Praising his men and sharing credit for achievements were part of his understanding of leadership" (Haughman 2002, p. 42) and "Shackleton contrived to save his crew through an astonishing mixture of inspirational leadership, courage, and good fortune" (Jones 2003, p. 7).

In contrast, Vilhjalmur Steffanson, leader of the ill-fated 1913 H.M.C.S. *Karluk* expedition to the Arctic, abandoned his ship and his men when it seemed probable that the ship would be caught fast in the ice. Steffanson left the expedition in the charge of the ship's captain, Bartlett, in order to pursue personal glory in further exploration of the north. His actions were in direct contravention to the instructions of the Official Journal of the Canadian Arctic Expedition 1913–1918 (Northern Party 1914–1918) that placed responsibility for the safe return of the party fairly and squarely on his shoulders (Niven 2000).

Two members of Steffanson's expedition who had previously travelled with Shackleton on H.M.S. *Nimrod*, Alistair Forbes Mackay (second surgeon) and James Murray (biologist), also abandoned ship, subsequently paying the ultimate price for their foolhardiness. Both are considered to have been put at risk through their earlier supportive association with Shackleton, since they are regarded as having a somewhat exalted idea of their own leadership skills. They "thought much more of their own experience with Shackleton ... If anything, that one expedition with Shackleton had given them a sense of too much power and confidence – false confidence, but confidence nonetheless. Bartlett was no leader, as far as they could see. Shackleton was a leader, and having served under him, they considered themselves leaders by association" (Niven 2000, p. 61).

Acknowledged during his lifetime as having exceptional leadership skills, Shackleton became a cult figure to future generations during the twentieth century and beyond. He was lauded as someone who, in extreme circumstances, kept his team together in a survival story described as incredible (Barczewski 2007). Morrell & Capparell agree: "In matters of leadership, the most reliable sources are the ones who are led ... Shackleton was an average person; he taught himself how to be an exceptional one. He rose above his peers and earned the unfailing loyalty of his men" (Morrell & Capparell 2001, pp. 10–11).

This raises the question of whether the components of leadership and popularity differ, according to an individual's personality? Successful leadership can and does exist without the leader necessarily being likeable. Mawson was respected as a great leader, but did not attract the hero worship that many ascribe to Shackleton. Liking is seen as essential to popularity.

Not many unpopular leaders receive adulation and it is not unreasonable to assume that men do not follow or espouse those who fail to inspire them. Inspiration is perhaps one of the more endearing virtues of leadership, as is passion. Many of the affectionate references to Shackleton made by his men are indicative of his popularity.

Scott's widow, Lady Kathleen Scott, upon hearing of the safe return of Shackleton and his men from the H.M.S. *Endurance* expedition, wrote in her diary: "I think it is one of the most wonderful adventures I ever read of, magnificent, Shackleton or no Shackleton" (Kennett 1949, p. 143). However, the general euphoria experienced on Shackleton's safe return with his men must be seen in the context of the British public's ongoing experiences of the First World War. So many lives had been lost, and continued to be lost, that the fate of a comparative few held less significance than might otherwise have been the case. Shackleton had received Prime Minister Winston Churchill's authority for the H.M.S. *Endurance* expedition to "proceed" in 1914, prior to their departure for Buenos Aires, the Weddell Sea and the Antarctic continent, but he and his men had returned to a world irretrievably changed from the one that they had left.

Following Shackleton's death on South Georgia, the *Geographical Review*, in 1922, published an obituary in his honour that read in part "With the death of Sir Ernest Shackleton, Britain loses one of the most brilliant explorers of modern days ... Shackleton's personality was not less interesting than his exploits. To his commanding personality, his courageous and indomitable spirit, and certain quality of "instinctive judgement" that together made for leadership in a supreme degree, tribute is paid by Hugh Robert Mill in a recent number of Nature (February 12, 1922), and a splendid portrait, 'Sir Ernest Shackleton: A Study in Personality,' is sketched by Charles Sarolea in the March number of the Contemporary Review".

ANTARCTIC TOURISM: ADVENTURE TOURISM, SHIP-BASED TOURISM AND QANTAS CONTINENTAL OVER-FLIGHTS

Another important aspect of Shackleton's enduring legacy is represented by the increasingly popular tourism industry in Antarctica and the sub-Antarctic. While many tourists visit Antarctica out of interest for the spectacular scenery or amazing wildlife, others are likely to do so as a result of long-standing interest in exploration undertaken during the Antarctic Heroic Era. Shackleton's legacy has resulted in him being one of the best known and most revered explorers of that time and for some fortunate visitors to the Ross Sea historic huts, or to Shackleton's grave in the whalers' cemetery at Grytviken, South Georgia, their experience becomes a once-in-a-lifetime pilgrimage.

Types of Antarctic tourism include adventure tourism, ship-based tourism, land-based exploration, private yacht excursions and Qantas continental over-flights. Some half-dozen Qantas flights per year leave from the Australian mainland capital cities of Sydney, Melbourne, Adelaide and Perth. Aircraft head south with the objective of flying over the areas of Antarctica made famous by Shackleton and his fellow explorers: the Ross Sea, Ross Island, the Trans Antarctic Mountains and Commonwealth Bay. Expedition ship-based voyages also depart from Australian and New Zealand ports for the historic hut landing sites in the Ross Sea or Commonwealth Bay. Ushuaia, Argentina, and Punta Arenas, Chile, are both departure ports for voyages to the South Atlantic Ocean and Weddell Sea, to the Antarctic Peninsula, to the Falkland Islands, and to South Georgia. Weather and ice conditions permitting, many voyages encompass visits to Elephant Island, where Shackleton's three lifeboats came ashore, to the whaling station at Stromness Bay and to Shackleton's grave at Grytviken (pl. 1).

The more extreme adventure tourism, as the name suggests, is undertaken by adventurers and explorers skilled in the more challenging sports arenas such as small yacht sailing, mountaineering, base jumping, deep sea diving, kayaking, parachuting and sky diving. These pursuits normally take place in the more remote areas of the world, of which Antarctica is certainly one. For many participants the ultimate challenge may be to follow in Shackleton's footsteps. One ambition can be to follow his early attempts on the H.M.S. *Discovery* and H.M.S. *Nimrod* expeditions from the Ross Sea towards the South Pole, or to cross the Antarctic continent from the Weddell Sea to the Ross Sea. Another is to emulate Shackleton's voyage in the lifeboat *James Caird* from Elephant Island to South Georgia and to attempt the crossing of the island's mountainous interior to reach the old whaling station at Stromness Bay. The 2012–2013 British-Australian expedition, suitably supported and led by world-renowned adventurer Tim Jarvis, successfully re-enacted Shackleton's 1916 voyage from Elephant Island to South Georgia and completed the hazardous crossing of the island. Their success was not without major difficulties, challenges and set-backs, however (Robertson & Darby 2013).

PLATE 1 — Shackleton's headstone at the Whalers' Graveyard, Grytviken (photo C. Hurley).

Modern expeditions have the advantage of having access to more accurate forecasting of suitable weather and ice conditions than was the case one hundred years ago. When the whalers of South Georgia warned Shackleton of heavier than usual pack ice to the south for the time of year, prior to his departure in H.M.S. *Endurance,* they spoke from extensive local knowledge. Notwithstanding his respect for their expertise, he ignored their advice, knowing that if he didn't depart within a certain timeframe he would be unable to complete the proposed journey due to the onset of the Antarctic winter.

Circumstances are now different. Most importantly, polar expeditioners are no longer alone in facing the unknown. Modern technology provides extensive information regarding anticipated terrestrial or marine challenges to be faced in polar travel. There is also the considerable advantage – practical as well as psychological – of virtually instantaneous communication with home base, together with expert advice on appropriate clothing, equipment and high-calorie food, facilities often unavailable or inadequate during the past.

Despite all these advantages, however, many modern expeditions fail, or come close to failure, notwithstanding availability of hi-tech communications and more than adequate provisions. For example, explorer Sir Ranulph Fiennes, one of the most able and experienced expeditioners of modern times, was forced to withdraw from a planned crossing of the Antarctic continent in mid-winter 2013 following severe frostbite to his hands during training (Collins 2013).

LEADERSHIP TRAINING METHODS AND CONTEMPORARY MANAGEMENT PRACTICES

The impact of Shackleton's legacy has also been felt in arenas other than the Antarctic. Contemporary management literature in the United States focuses on the lessons to be learned from Shackleton's leadership and his bonding work with his "teams". Morrell & Capparell (2001, frontispiece) reported "those who have taken Shackleton's leadership lessons to heart" as including "the Secretary of the Navy, the Commander of Apollo 13, and the Co-founder of TheStreet.com". The book's Introduction and subsequent chapters reflect at length upon Shackleton's many accomplishments and their relevance to modern-day issues: the path to leadership; hiring an outstanding crew; creating a spirit of camaraderie; getting the best from each individual; leading effectively in a crisis; forming teams for tough assignments; overcoming obstacles to reach a goal, and leaving a legacy (Morrell & Capparell 2001).

As a skilled judge of men, Shackleton exhibited exceptional maturity in his understanding of the difficulties of putting together an ideal crew. A good example of this ability is his recollection of a London theatrical manager's observations that "character and temperament matter quite as much as acting ability". In this instance Shackleton responded by saying that "he had to balance his types too, and their science and seamanship weighs little against the kind of chaps they were" (Morrell & Capparell 2001, p. 56).

Blair W. Browning (2007) draws a comparison with three leadership approaches/theories: skills approach, style approach and contingency theory. He utilises a non-fiction piece of literature as an example of how leadership theory can be taught or discussed using a(n) historical event re-created through the text as a way of understanding this pertinent aspect of organisational life.

John C. Maxwell, in considering the qualities of well-known American identities over time, cites: "character; charisma; commitment; communication; competence; courage; discernment; focus; generosity; initiative; listening; passion; positive attitude; problem solving; relationships; responsibility; security; self-discipline; servanthood; teachability and vision" as being indispensable leadership qualities (Maxwell 1999, p. vi). He then goes on to claim "Everything rises and falls on leadership. And leadership truly develops from the inside out. If you can become the leader you ought to be on the inside, you will be able to become the leader you want to be on the outside. People will want to follow you. And when that happens, you'll be able to tackle anything in this world" (Maxwell 1999, p. xi).

James C. Humes (1991), communications consultant and speech writer for every American President from Eisenhower to Bush, is passionate in his belief that "the difference between mere management and leadership is communication, and that art of communication is the *language of leadership*" (Humes 1991, p. 14). Shackleton had the advantage of being born with the ability to communicate with all classes and levels of people at a personal as well as a professional level, an advantage honed by his enlistment and lengthy period of service in the British Merchant Navy prior to his expeditionary exploits.

CONCLUSION

Research into Shackleton's enduring legacy has indicated that very little is achieved without passion and with it the determination to proceed at all costs. Shackleton's particular passion started out as a thirst for the excitement afforded by exploration, as an attraction for the polar regions and for the solitude afforded by ultimate wilderness. However, this indulgence very quickly became a preoccupation with Antarctica. Shackleton never wavered from his desire to travel south, to be in the first party to reach the South Pole, to ensure that a British expedition be the first to cross the Antarctic continent, and to achieve the first circumnavigation of Antarctica.

Shackleton's allegiance to the men who served under him on his four expeditions south is well noted. He was also steadfast in his determination to extend and expand upon what was then comparatively limited knowledge of the Antarctic continent and Southern Ocean. That the culmination of these ambitions ultimately cost Shackleton his life at a comparatively early age is not surprising. Aged forty-six, he had undergone more physical hardships than many men will ever experience. An engaging, practical, down-to-earth and yet poetical man, many of those who knew him, as well as subsequent biographers, depict him as having possessed to a very high degree that measure of humanity and competence which governed his every endeavour.

Shackleton's enduring legacy therefore extends to many facets relevant to the twenty-first century. In addition to his leadership attributes and management skills, to his contribution to British/Australian sovereignty in Antarctica through scientific discovery and exploration, and to Antarctic tourism, as recounted earlier, there is another consideration.

Shackleton's lifelong passion for Antarctica enables all of us to better understand our own often inexplicable attraction to this part of the world, our inalienable regard for this most beautiful and desolate wilderness area, and our resolution to do everything within our respective capabilities to ensure its continued protection well into the future.

Shackleton's widow, Emily, was well aware of his passion for wilderness and for Antarctica. Upon learning of his death on South Georgia, she requested that his body be returned there for burial from Uruguay, where it had been taken, knowing that this was what he would have wished (Albert 1960, Mortimer 1999). Shackleton's grave (pl. 1) in the whalers' cemetery at Grytviken is the only one with the headstone facing due south, towards the Antarctic. The headstone itself is engraved simply "To the dear memory of Ernest Henry Shackleton, Explorer, Born 15 February 1874, Entered life eternal, 5 January 1922" (Haughman 2002, p. 110).

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BOOK REVIEW

by Margaret Davies

Tadpoles and Frogs of Australia
by Marion Anstis

New Holland, Sydney, 2013: 831 pp. ISBN 9781921517310, $125
($145 for the limited edition, ISBN 9781921517167, signed, individually numbered.)

To any Australian herpetologist, or indeed any herpetologist full stop, as well as to anyone interested in natural history, this extraordinary volume is a true gem. Marion Anstis has provided to the scientific community the most amazing resource, and all within one (albeit extremely heavy - about 4 kg) volume. The book well deserves the descriptor of being a tome. Its publication is the result of an amazing journey of an extraordinary woman. A music teacher by training and profession with a passion for tadpoles, Marion has travelled the continent to find, identify, rear and describe that most enigmatic of life histories – from mating, to egg laying, to larval stage, followed by metamorphosis to fully formed frogs –a journey begun in 2001, culminating in a PhD thesis and this massive publication.

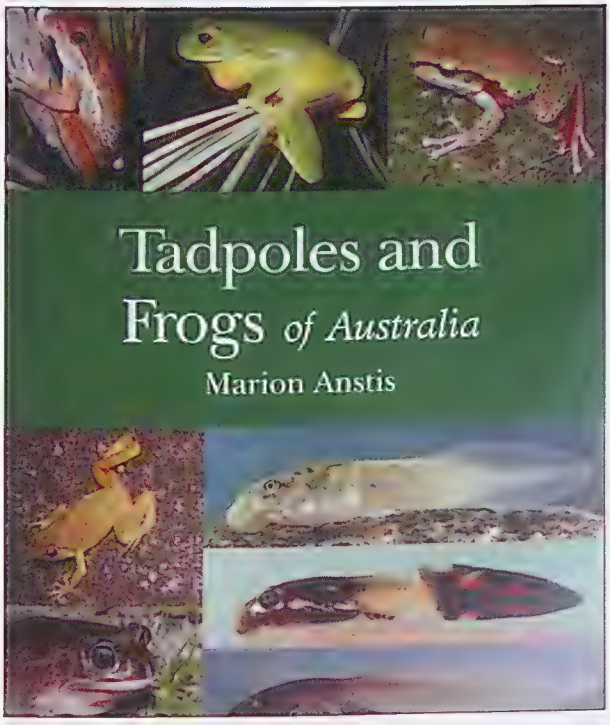
As a former tadpole nurturer, I can attest to the hours of care, the frustrations and the pleasures of success, but Marion has exceeded anything that has ever gone before. With a mobile laboratory in her van, she has intrepidly gone where few have ventured, and the result is this extraordinary wealth of knowledge brought together is this volume.

Marion has developed methods of photographing tadpoles that give accurate and diverse views of these so difficult to identify life history stages. These methods are generously shared in the book, as are all sorts of tips on rearing tadpoles.

The book is divided into three sections. Part I provides useful background to frog classification, to the recognisable stages in the development of free-swimming tadpoles, beautifully illustrated with line drawings, followed by information on collecting and raising tadpoles, notes (accompanies by extraordinary photographs) on predators and a discussion of conservation issues.

Part 2 is chock full of great information on the parts and features of tadpoles useful for identification. Anstis defines 23 different tadpole types, then describes oral disc structure and defines 20 individual types. All this information is lavishly illustrated with line drawings. A key to the genera of tadpoles and of direct developing frogs follows. As anyone who has constructed keys will know, this is no mean feat. In fact the entire book is punctuated by keys to tadpoles and eggs of individual genera – a mammoth undertaking, and of massive value to any field biologist.

The book is not only about developmental stages: adults, too, get a guernsey, so a page of adult features is followed by discussion of eggs and embryos, together with



beautiful photographs of different kinds of egg masses. All this information is then used to provide the 722 pages of species information about the 241 species recognised when the book was published.

Species are treated by family and genus and accounts include descriptions of adults, notes on their distribution and breeding, verbal descriptions of call, followed by descriptions of egg clutches, embryos, tadpoles, the oral disc, metamorphosis, behaviour together with comparisons with similar tadpoles. Each account is supplemented with superb photographs and line drawings of appropriate larval stages, or features, if necessary, together with a distribution map.

Keys to tadpoles and or eggs for appropriate genera are provided. The keys rely on knowledge of where the specimens have come from, as there are insufficient differences in larval features for all-encompassing keys to be workable. This is not a failing, as specimens without collection data are of little use in understanding their value.

It would be extraordinary if a work of this scale did not have some imperfections. Yes, there are missing parentheses

in authority designation (e.g., *Limnodynastes lignarius* (Tyler, Martin & Davies, 1979)); yes, the distribution data for species are not always accurate (e.g., five species missing from Victoria); yes, the odd key feature use for separating adults is missing (such as the continuous dark stripe on the anterior tibia of *Litoria tornieri*), but these cannot detract from what is an amazing piece of work.

Marion Anstis and those organisations that have supported her throughout this enterprise, together with those who have supplemented her own illustrations with other photographs, can only be congratulated on the production of a book that will probably never be matched anywhere on the planet.

I can only be in awe at Marion's contribution to herpetology, to science and to natural history. What a wonderful legacy!

Margaret Davies OAM is a herpetologist who retired in 2002 from the University of Adelaide after 30 years where she spent 28 years researching the Australo/Papuan frog fauna. She has discovered and named 35 species of frog and authored/co-authored/edited or coedited over 120 publications, including tadpole descriptions. She has undertaken field work in remote parts of the country and has a huge empathy for all that Marion Anstis has achieved.

OBITUARY

Maxwell Robert Banks AM, D.Sc., D.H.C. (Lille)

21 July 1925–24 October 2014

Maxwell Robert Banks was for several decades, a leading contributor to Tasmanian cultural life, especially that arising from his broad interests in geological and related phenomena. He was born in Punchbowl (Sydney) where he obtained his primary and secondary school education. At the end of school, during World War II, he worked for times as a shop assistant, a welder's assistant, a clerk in a grocery wholesaler and then as a cadet chemist. He had seen his career as being in industrial chemistry but that now changed. His supervisor in his cadet's role suggested he think about geology as that seemed to fit with all his interests in the outdoors. His advisor was A.J. Lambeth who went on to be part of the first year of the Australian National Antarctic Research Expeditions (ANARE) to Heard Island for 1948.

Max was granted a Public Exhibition to the University of Sydney and decided to include Geology in his studies. That was a life-changing decision. He graduated from the University of Sydney in May 1947 with First Class Honours in Geology and was awarded the University of Sydney Medal and the Deas Thomson Scholarship for Geology.

In the same year, he was appointed to the University of Tasmania as Demonstrator in Geology, the first appointment to the new Geology Department, under Professor S. Warren Carey. Also in that year, he joined The Royal Society of Tasmania and went on to have a 67-year association with this Society, serving with distinction in every important position.

The Royal Society of Tasmania associations

Max Banks served as:

Member of Council 1966–1968, 1973–1975
Junior Vice-president 1971, 1972, 1993
Senior Vice-president 1972, 1973, 1994 (at that time the President was *ex officio,* the Governor of Tasmania)
Honorary Secretary 1995–1996
Honorary Editor of the *Papers and Proceedings of the Royal Society of Tasmania* 1973–2000 (27 years)

His contribution to the Society and to Science was recognised by the award of the Royal Society of Tasmania Medal (1978) and the establishment of the M.R. Banks Medal for outstanding achievement by a scholar in mid-career. He was made a Life Member of the Society in 1986.

Max was nominated by The Royal Society of Tasmania to be its representative on the Board of Trustees of the Tasmanian Museum and Art Gallery from 1974–1984, leading to his chairing of that body 1979–1984.

He was a regular author of papers alone or in collaboration with others in the *Papers and Proceedings of the Royal Society of Tasmania.*

His interests expanded into an understanding of the history of the natural sciences in Tasmania, nowhere better exemplified than in his activities in relation to the visit to Hobart in 1836 by Charles Darwin. Banks, in collaboration with others, researched the significance of Darwin's visit, and this influenced strongly the travels to sites associated with Darwin during Banks' study leave. Several publications emerged from that study.

Academic career

Max Banks' academic career was based entirely at the University of Tasmania where he advanced through the academic ladder from Demonstrator, to Lecturer (1948), Senior Lecturer (1952), to Reader (1966 until retirement in 1990). He enjoyed study leaves at Amherst College (Massachusetts, USA), at the University of Queensland, and at University of Cambridge.

Along the way, he received a Doctorate (*Honoris causa*) from the University of Lille (France) (1977) and D.Sc. from the University of Tasmania (1978).

He is very highly respected by his past students, many of whom have gone on to have distinguished careers of their own but who kept in touch regularly. This respect was earned by his openness, honesty, straightforward manner, wide-ranging knowledge, humour, strength as a field geologist, and teacher in the field. Those who worked with him at the University and elsewhere knew of his loyalty and his diplomacy which was called upon often to mend bridges for the Geology Department when passions had overflowed into disputation.

His contributions to Tasmanian geology are illustrated in his publication record but that is only part of the story. He was available to anyone who needed access to his knowledge base which was much greater and wider than his published record.

Max's activities were not restricted to Tasmania; he was a Founding Member of the Geological Society of Australia, and its Federal President 1965–1966, leading to Honorary Life Membership in 1992. He was councillor of the Australian Institute of Cartographers (1958-1967) and Federal President (1960). He served on many Tasmanian committees, educational, church and science-associated.

Max Banks was recognised by his country when he was made a Member of the Order of Australia (AM) in 1981 in recognition of service to the community and science.

Throughout this distinguished career, Max was ably and proudly supported by his wife Doris (née Ingram). They married in 1955 and have five children. Max and Doris have been for many years, regular attendees at The Royal Society of Tasmania functions.

Max Banks epitomised the descriptor of a "scholar and a gentleman". His legacy is profound.

Patrick G. Quilty AM

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